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(54) **MOTORIZED TREADMILL WITH MOTOR BRAKING MECHANISM AND METHODS OF OPERATING SAME**

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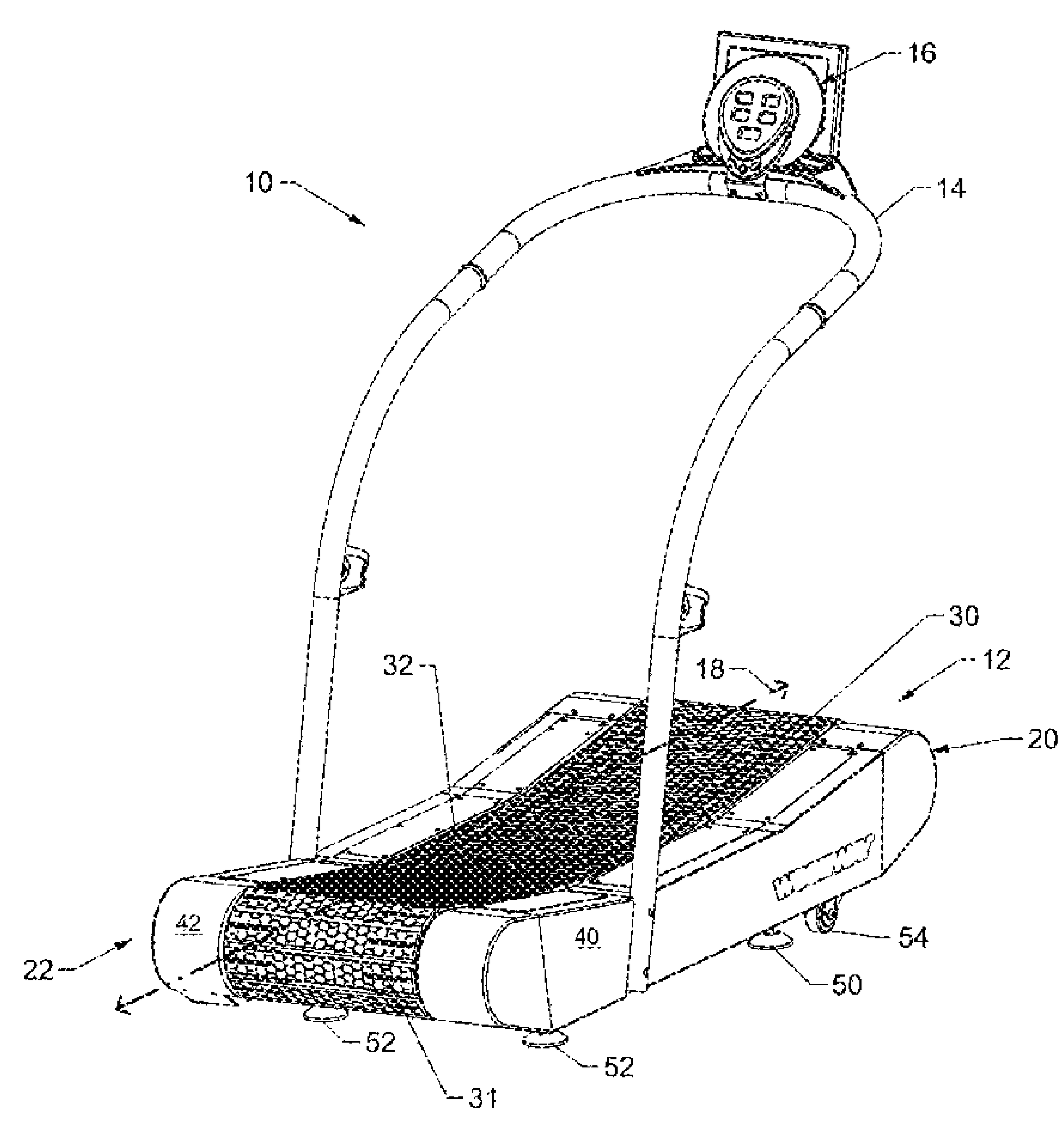
(57) **ABSTRACT**

A treadmill includes a frame; a running belt configured to move relative the frame; and a motor coupled to the running belt. The motor is operable in a plurality of user controlled operating modes. In a first operating mode, the force of rotation of the running belt is provided by a user of the treadmill. In a second operating mode, the motor applies a desired braking force to resist rotation of the running belt. In a third operating mode, the motor applies a torque output to the running belt based on a force exerted on the running belt by a user of the treadmill.

20 Claims, 15 Drawing Sheets



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See application file for complete search history.

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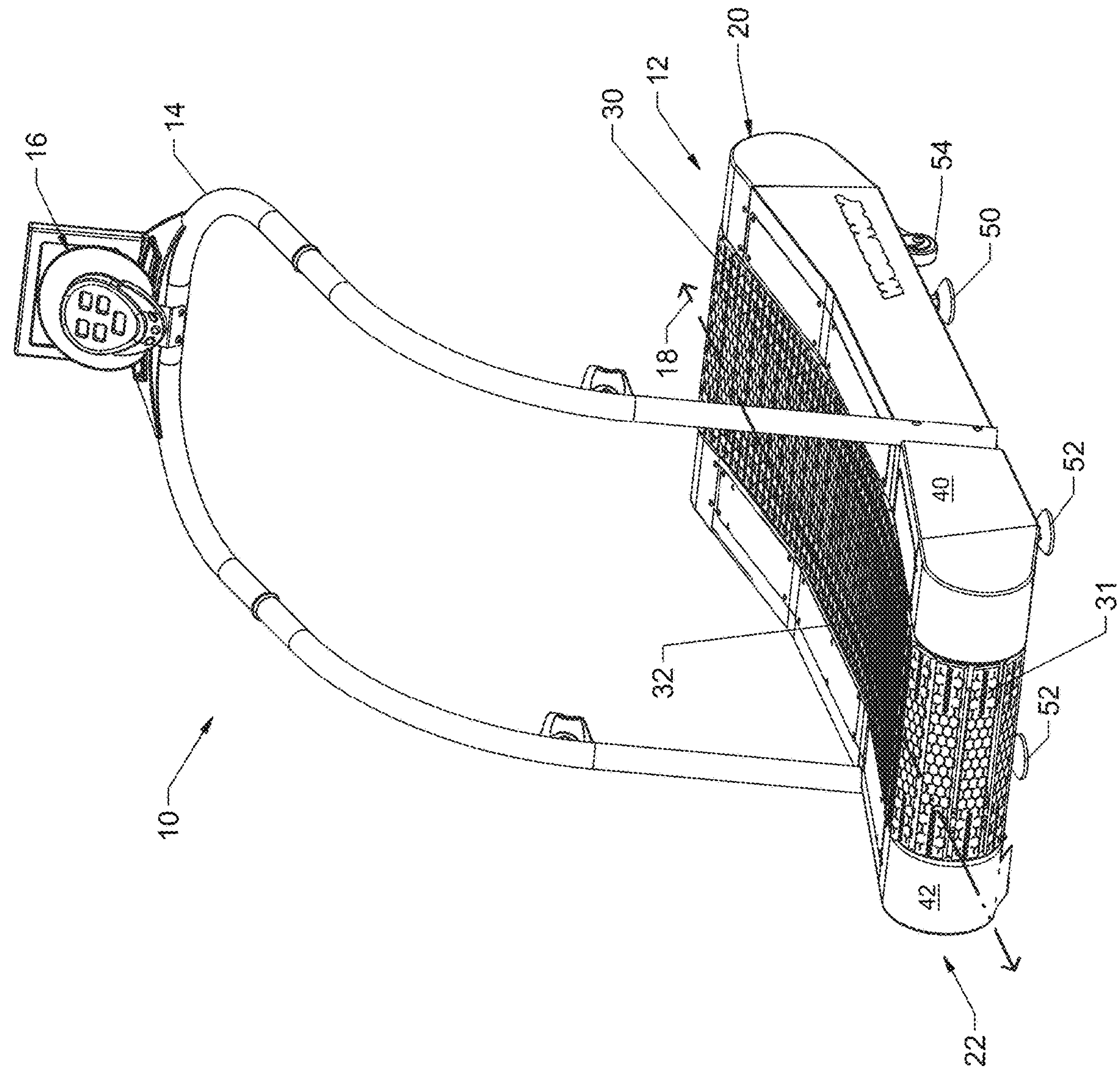
FIG. 1



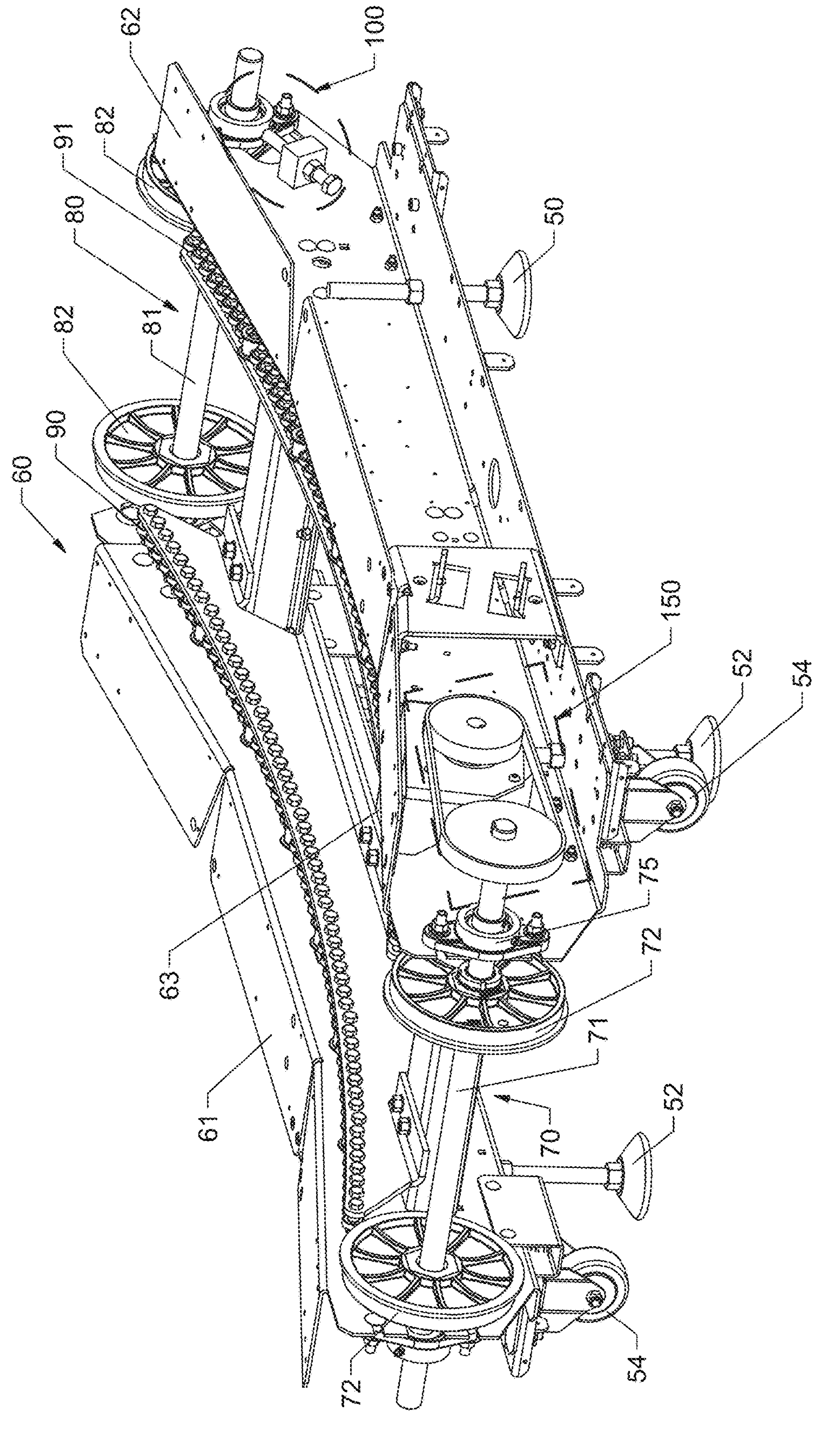


FIG. 2

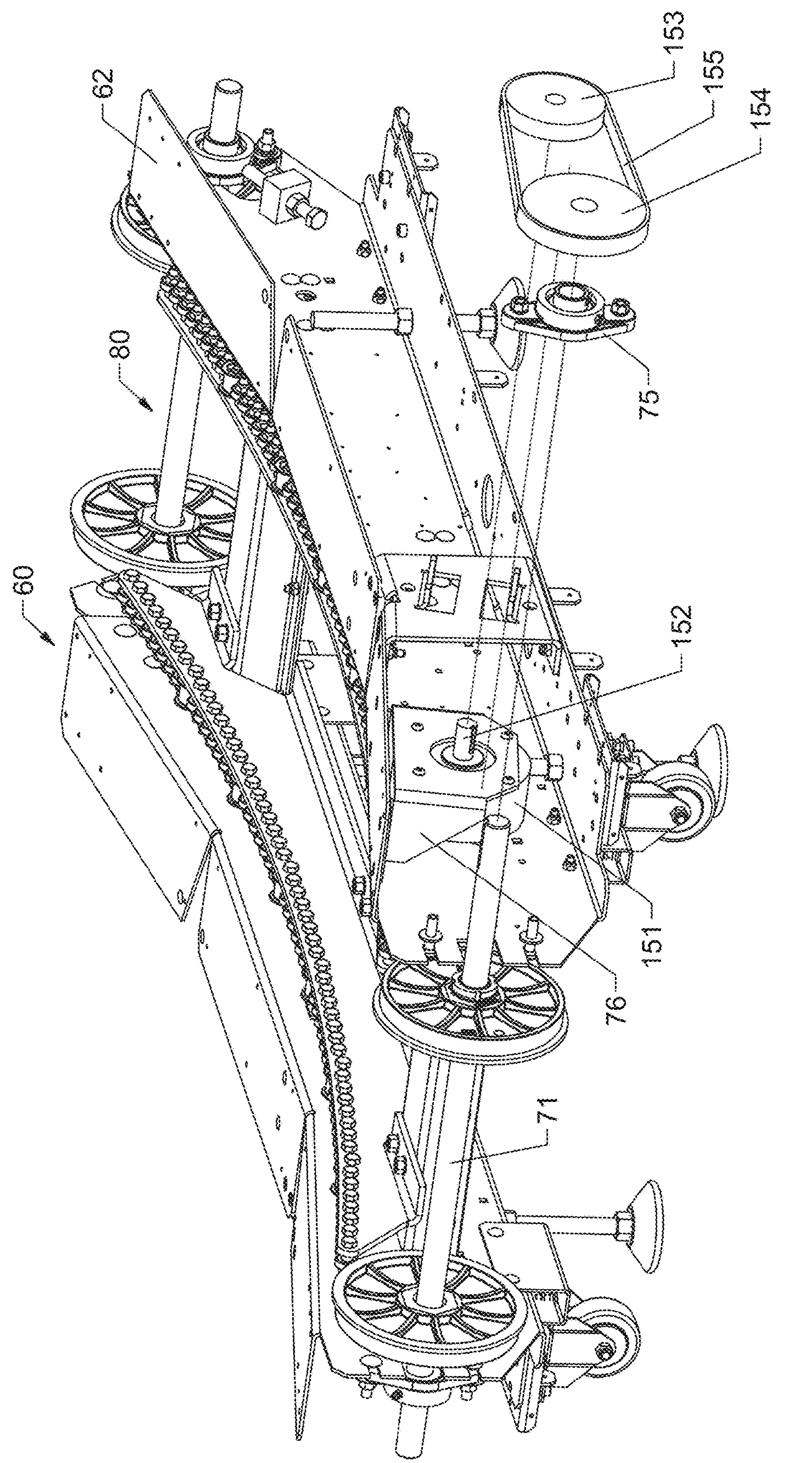


FIG. 3

FIG. 4

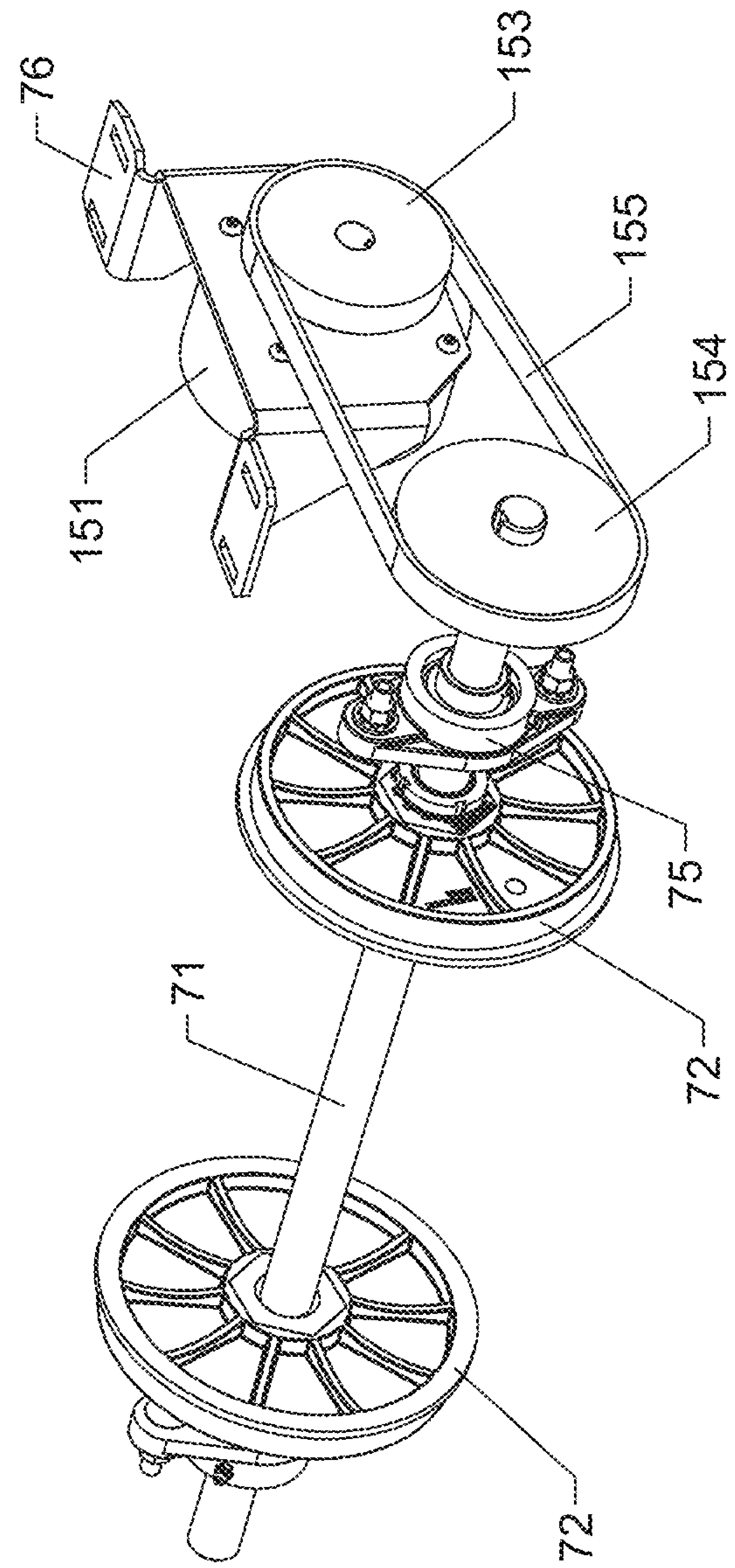
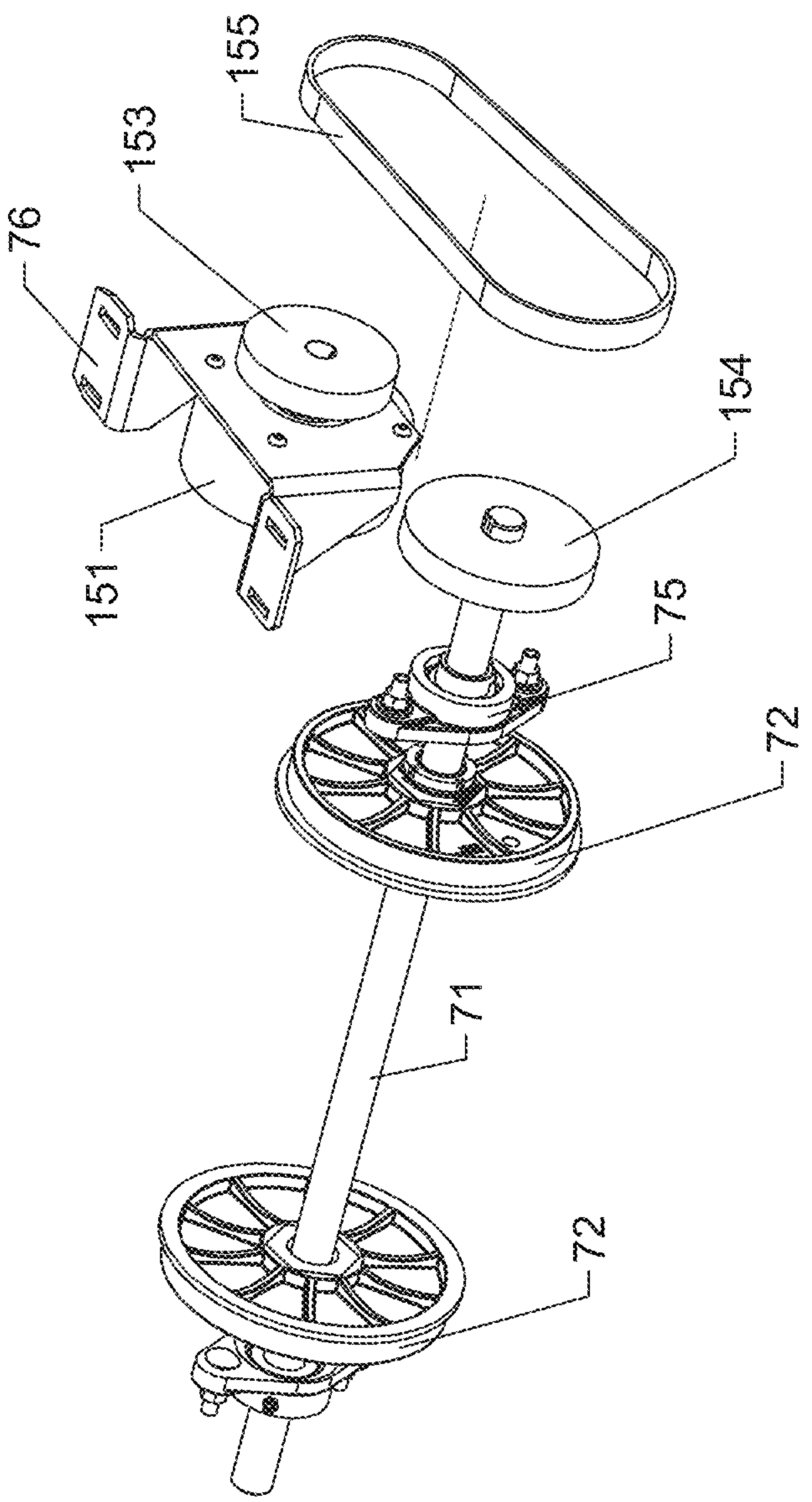


FIG. 5



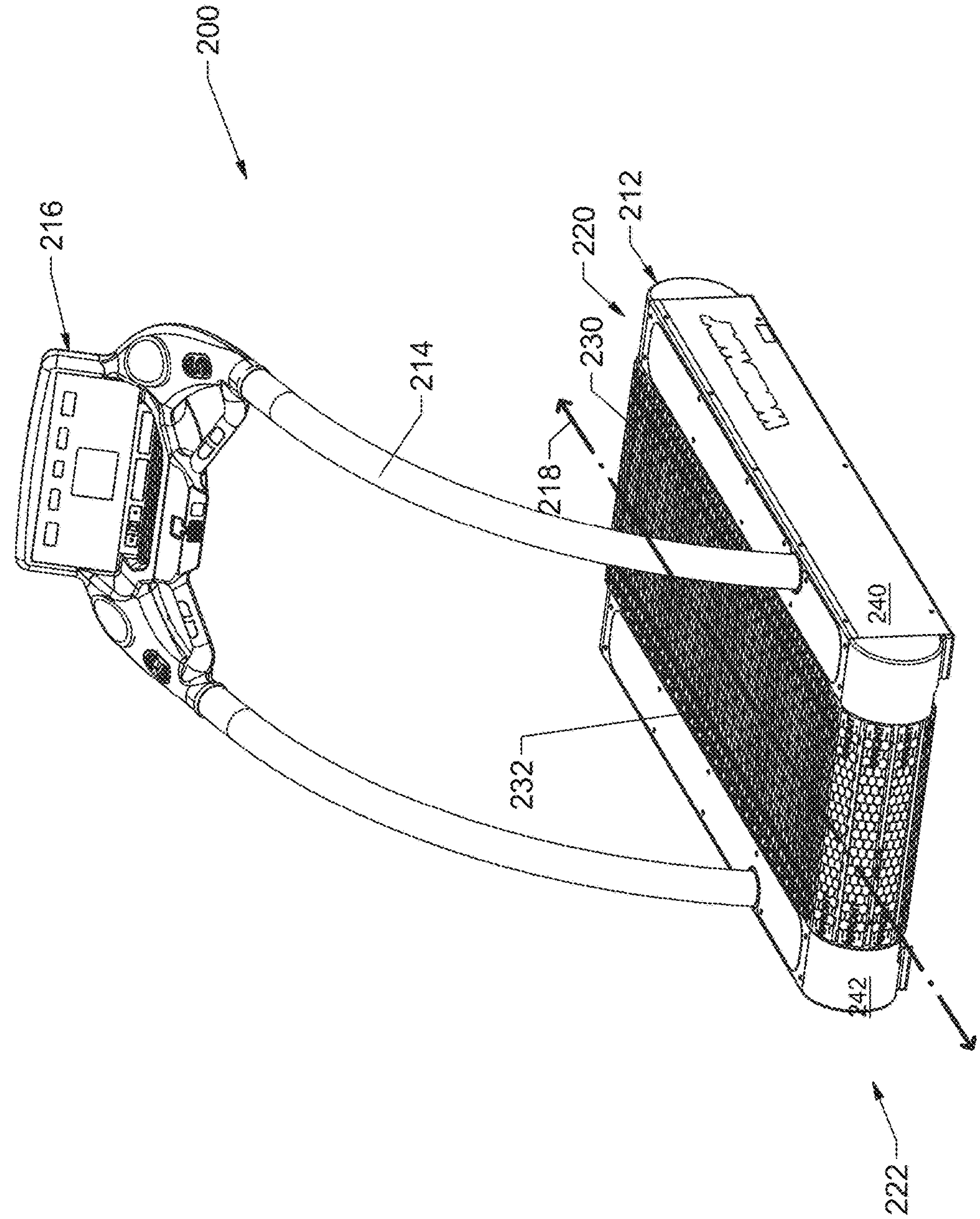


FIG. 6

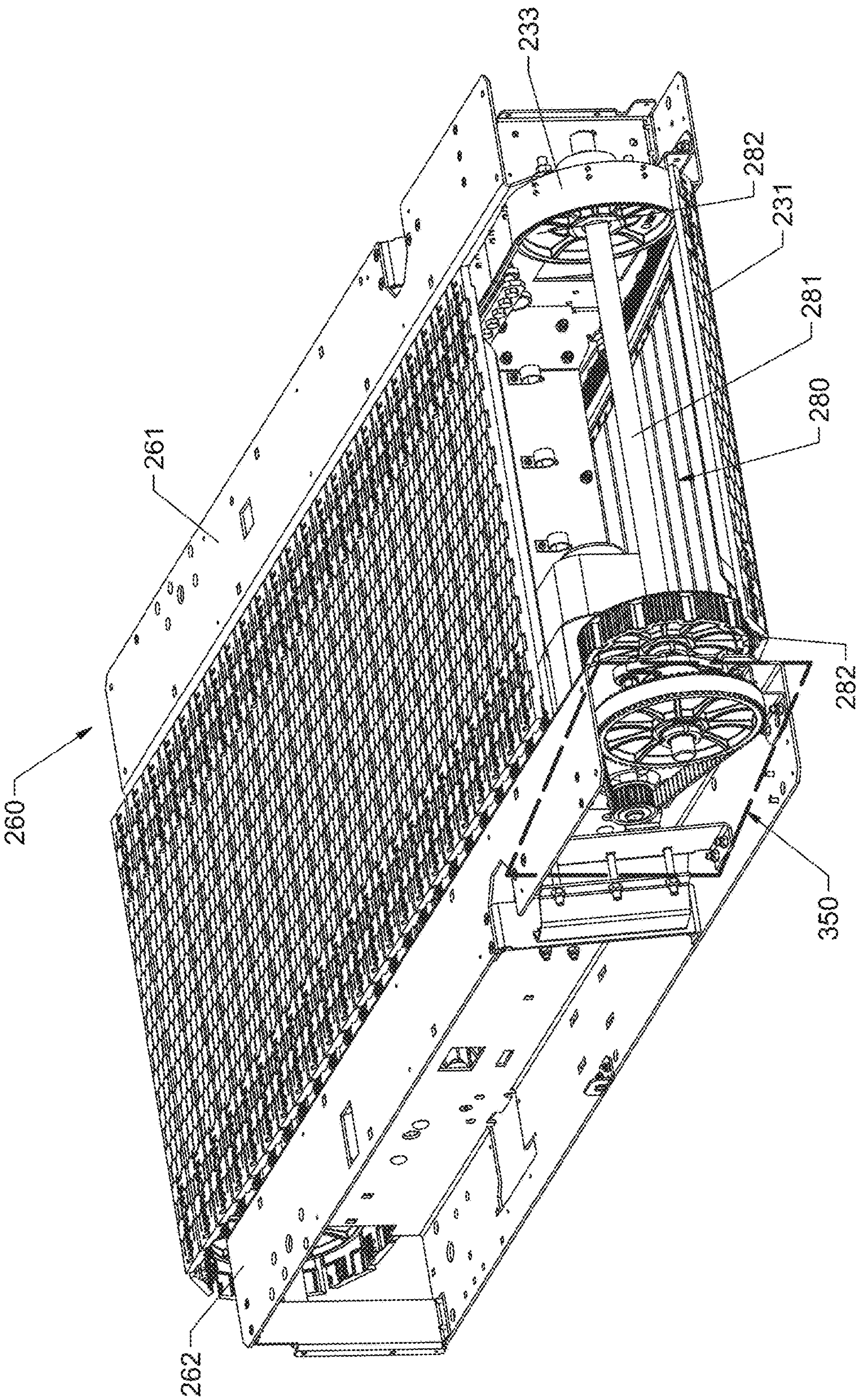


FIG. 7

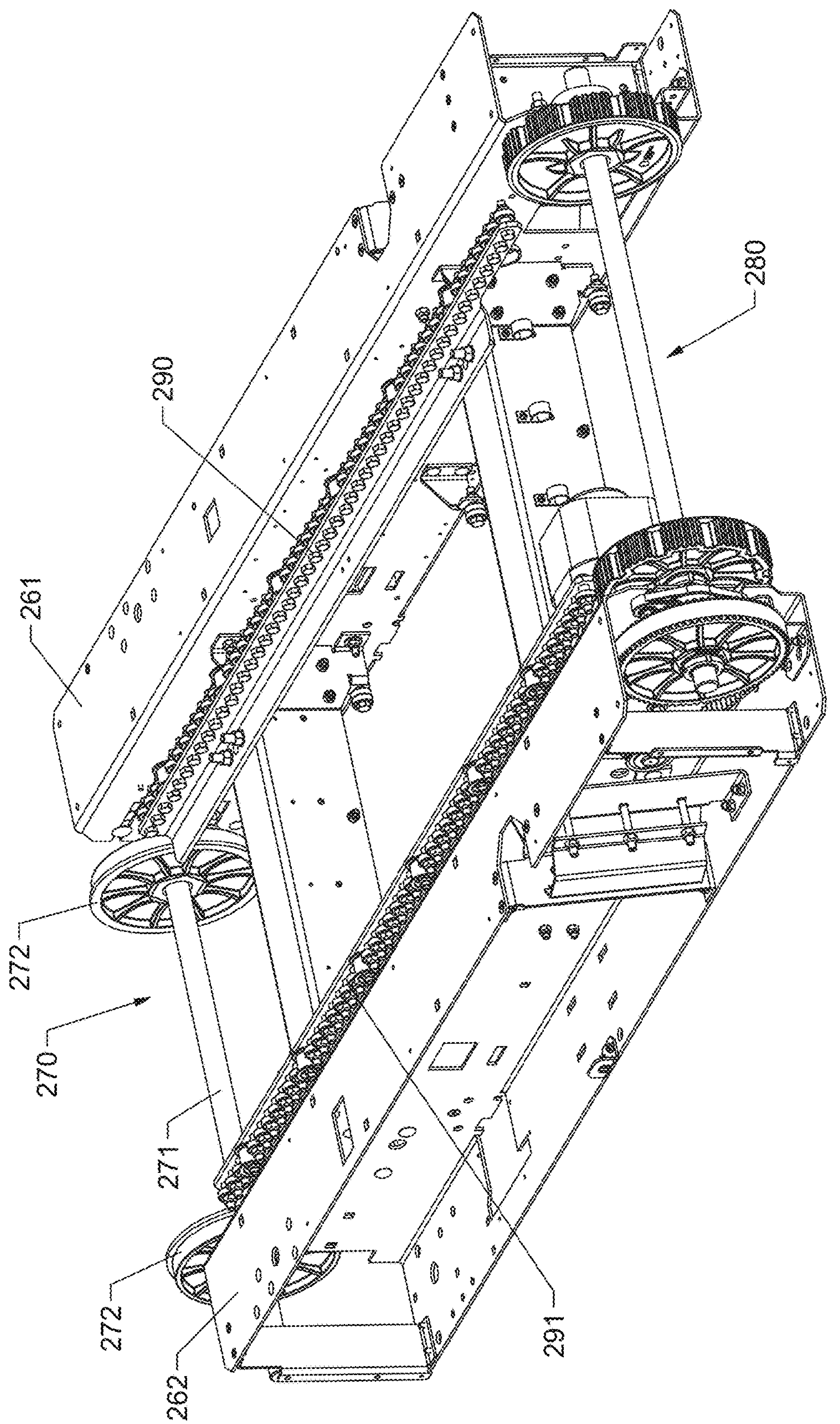


FIG. 8

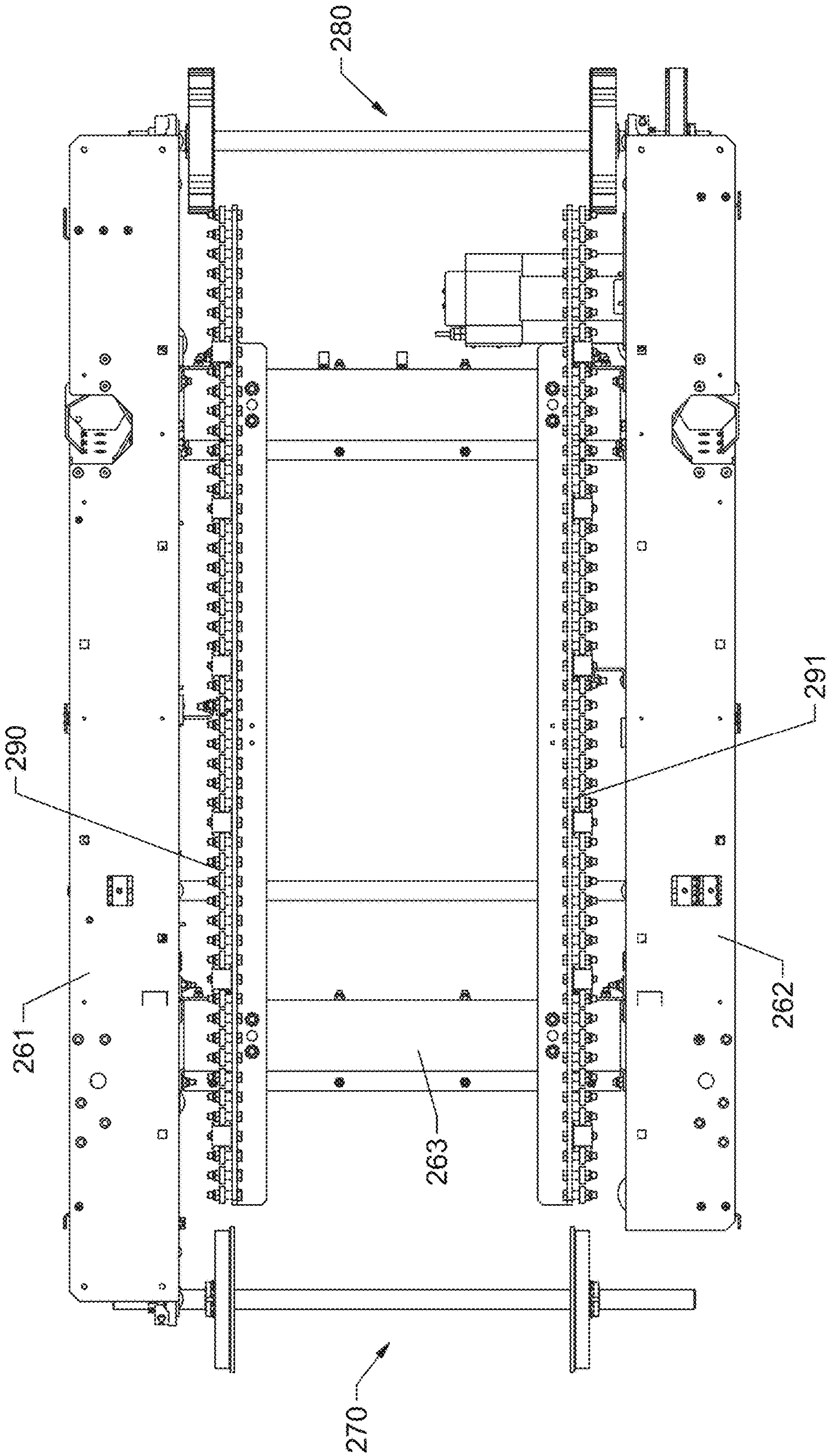


FIG. 9

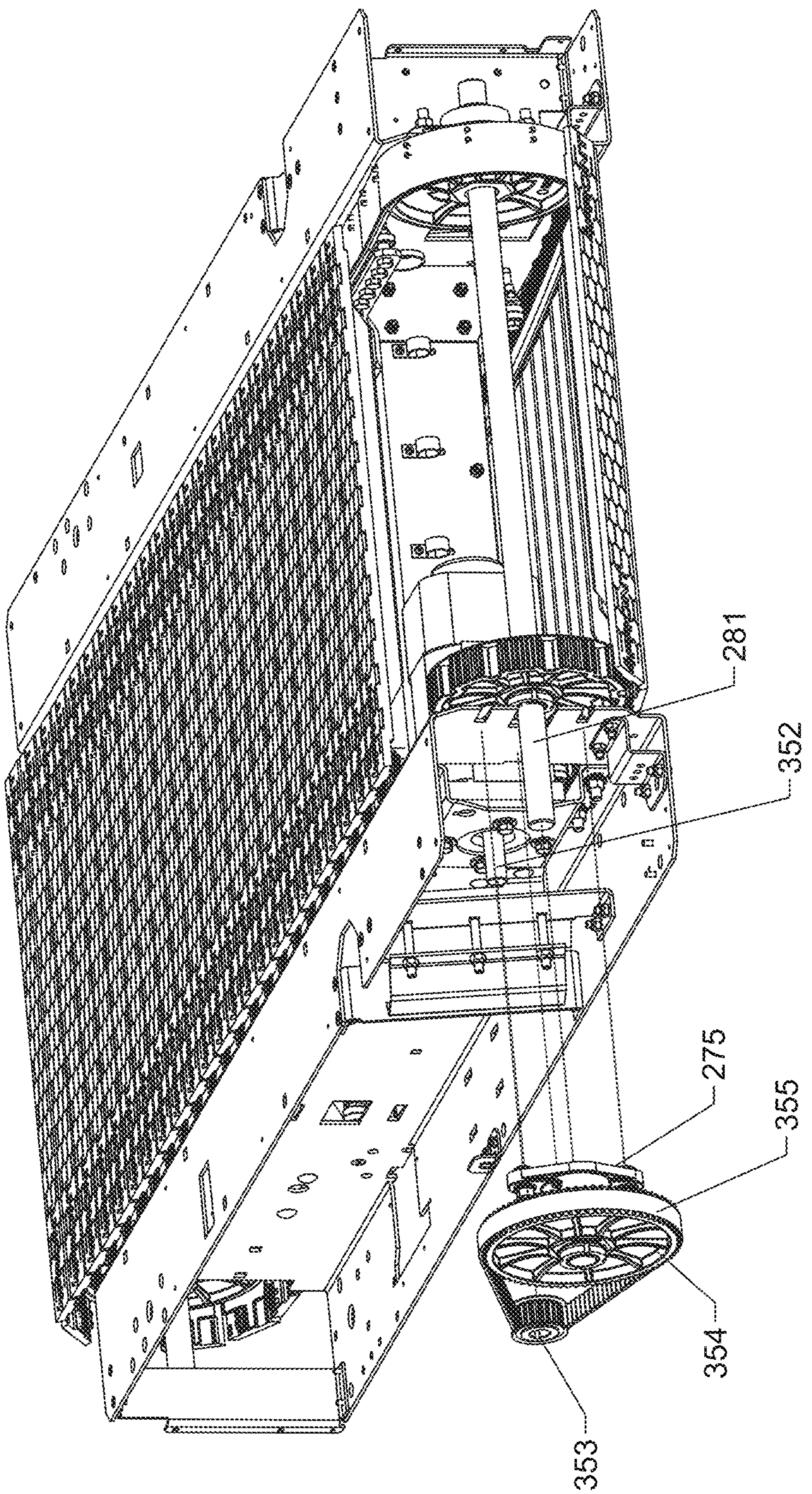


FIG. 10

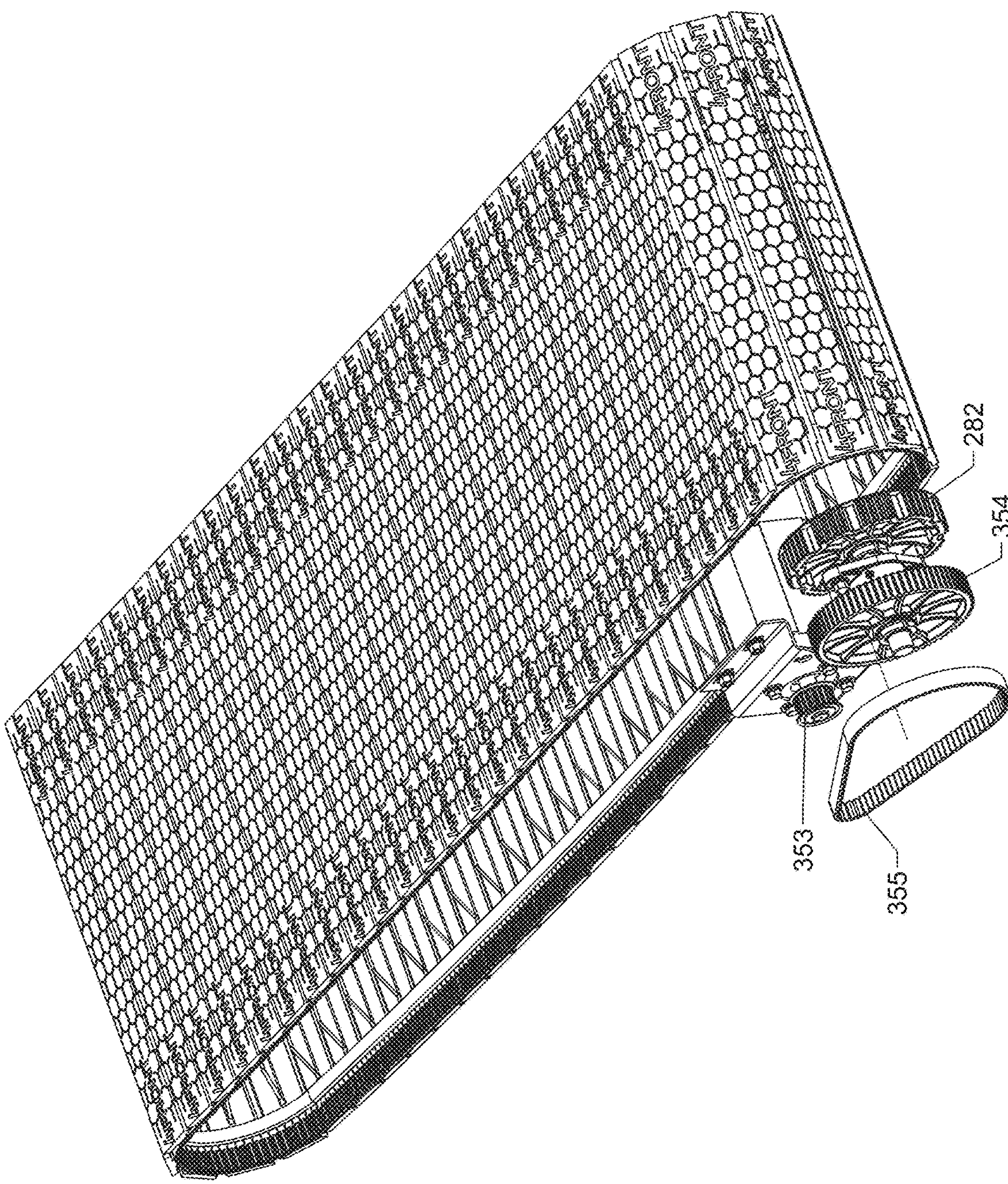


FIG. 11

FIG. 12

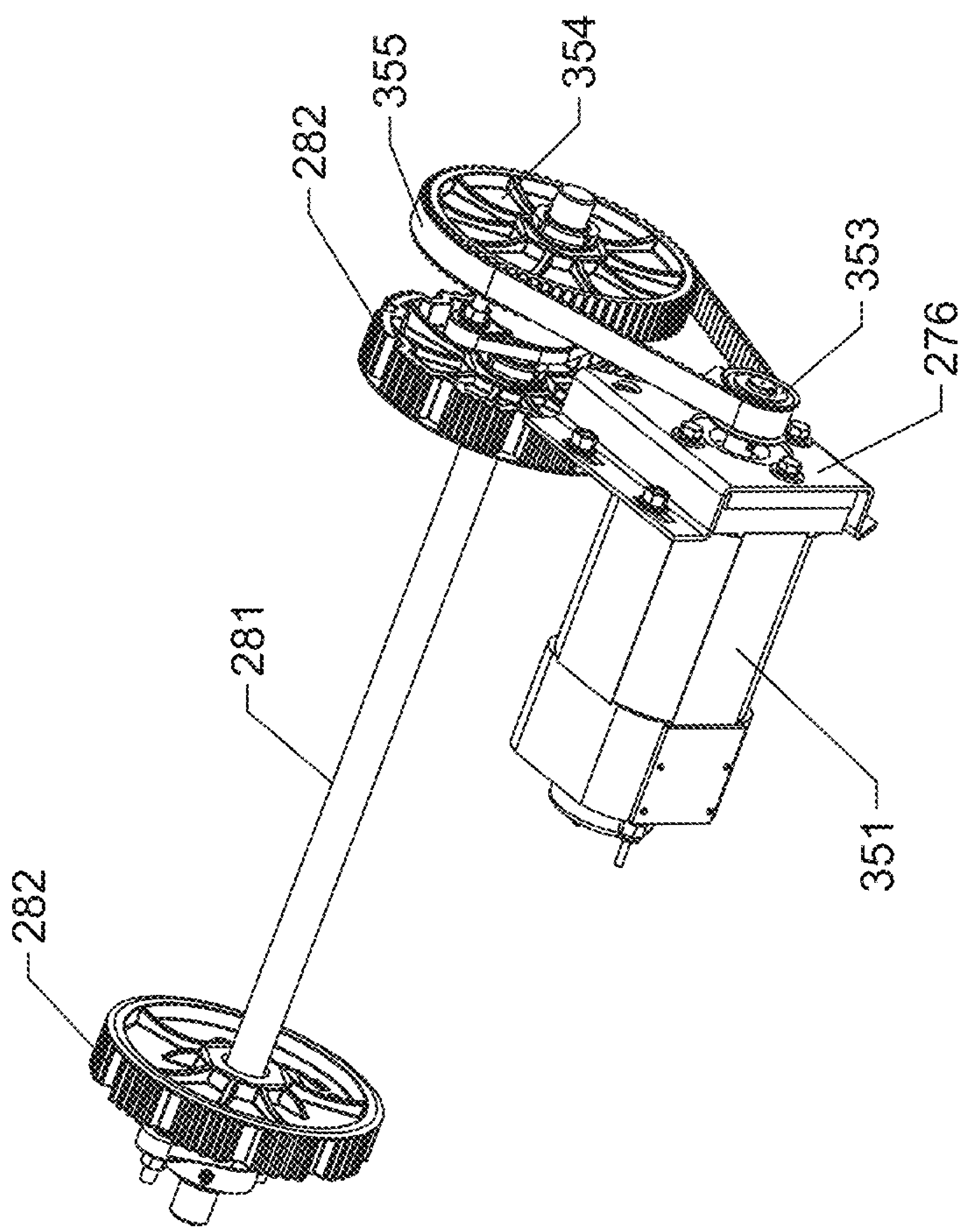
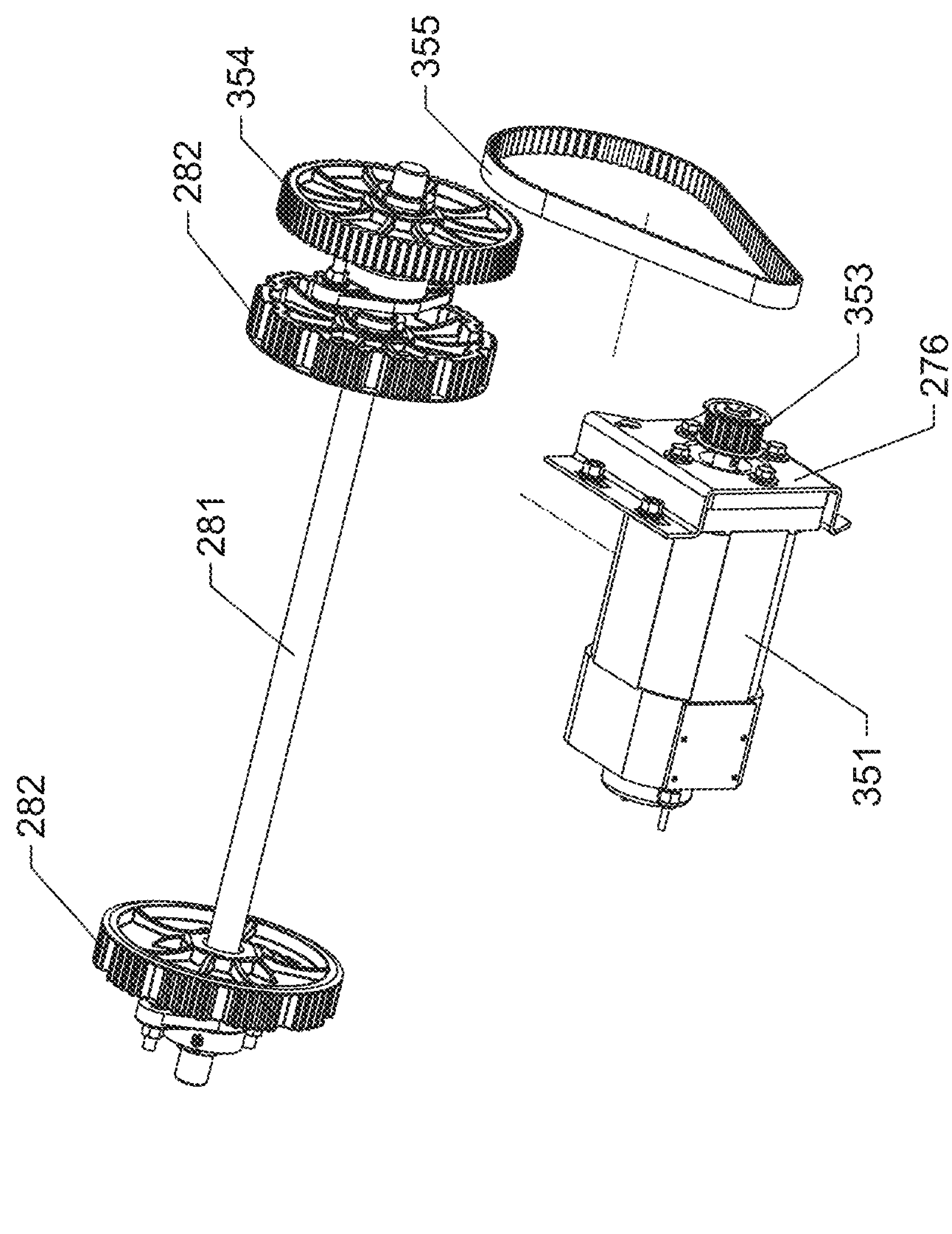
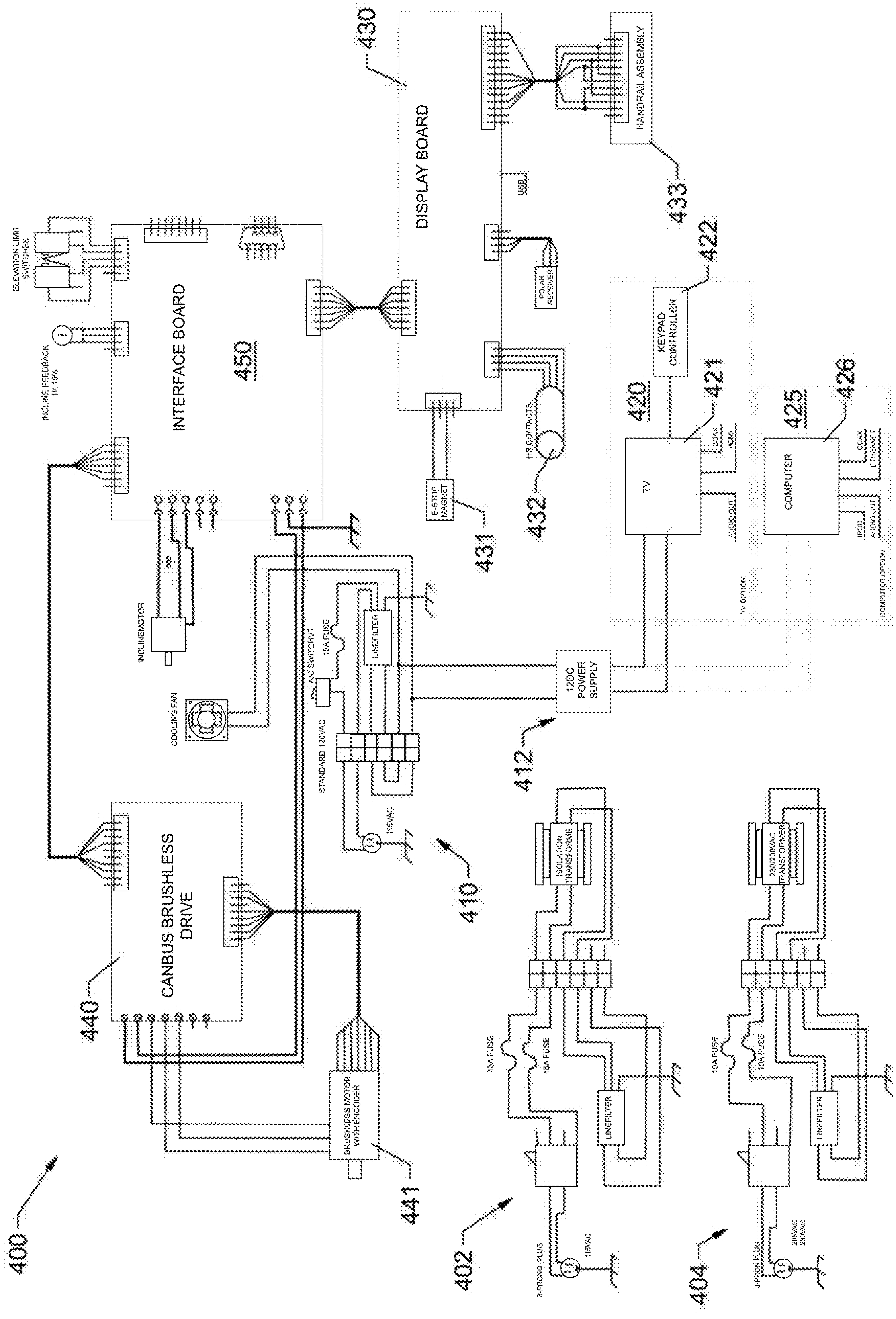


FIG. 13





400
402
404
410
412
420
421
422
425
426
430
431
432
433
440
441
450
DISPLAY BOARD
INTERFACE BOARD
CANBUS BRUSHLESS DRIVE
HANDRAIL ASSEMBLY
KEYPAD CONTROLLER
TV
COMPUTER
12DC POWER SUPPLY
E-STOP MAGNET
HR CONTACTS
POLAR RECEIVER
USB
ELEVATION LIMIT SWITCHES
INCLINE FEEDBACK
INCLINEMOTOR
COOLING FAN
LINEFILTER
15A FUSE
10A FUSE
AC SWITCH
STANDARD 120VAC
115VAC
ISOLATION TRANSFORMER
BRUSHLESS MOTOR WITH ENCODER
TV OPTION
COMPUTER OPTION
AUDIO OUT

FIG. 14

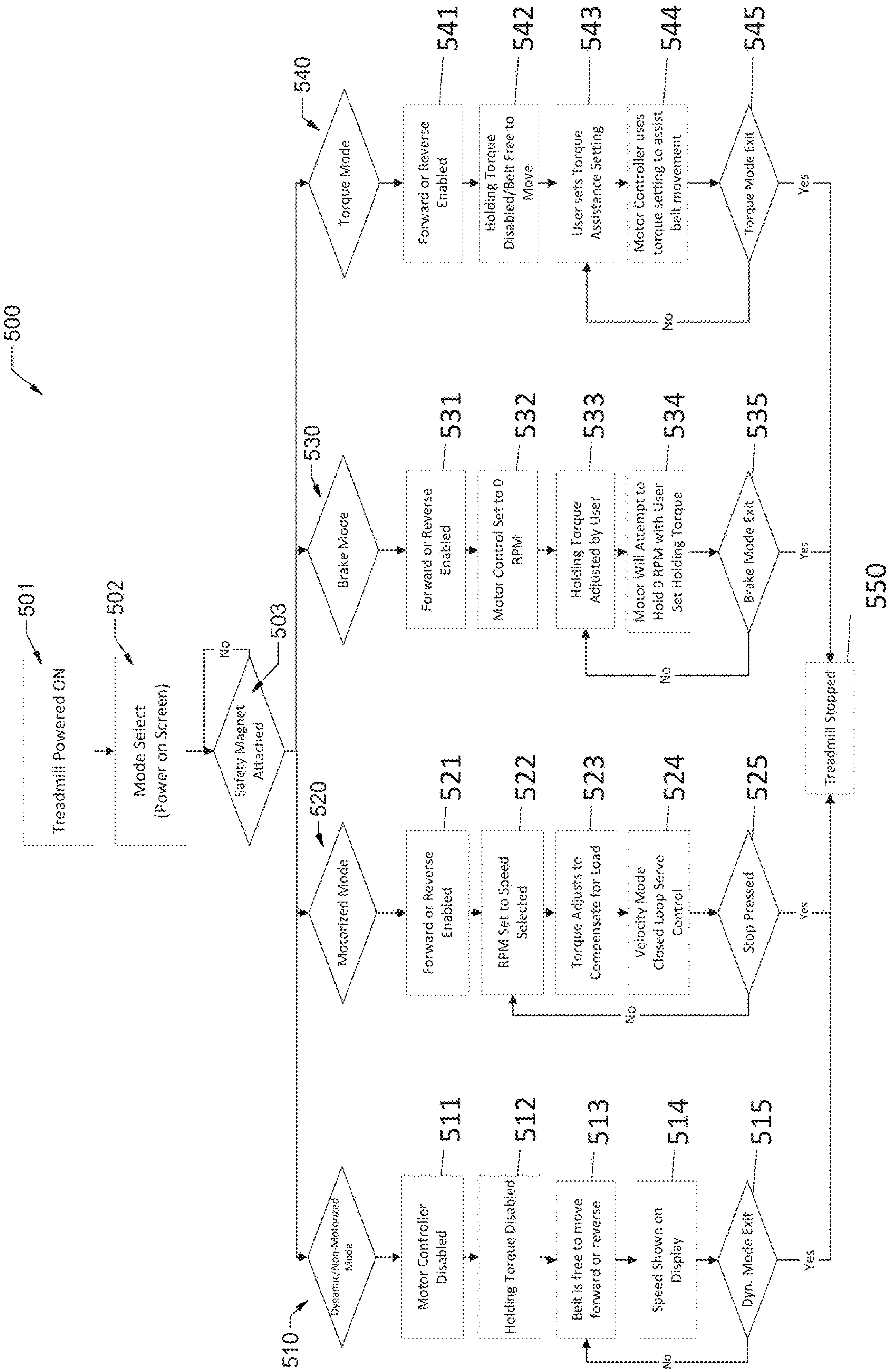

500
501
Treadmill Powered ON
502
Mode Select (Power on Screen)
503
Safety Magnet Attached
No
510
Dynamic/Non-Motorized Mode
511
Motor Controller Disabled
512
Holding Torque Disabled
513
Belt is free to move forward or reverse
514
Speed Shown on Display
515
Dyn. Mode Exit
No
Yes
520
Motorized Mode
521
Forward or Reverse Enabled
522
RPM Set to Speed Selected
523
Torque Adjusts to Compensate for Load
524
Velocity Mode Closed Loop Servo Control
525
Stop Pressed
No
Yes
530
Brake Mode
531
Forward or Reverse Enabled
532
Motor Control Set to 0 RPM
533
Holding Torque Adjusted by User
534
Motor Will Attempt to Hold 0 RPM with User Set Holding Torque
535
Brake Mode Exit
No
Yes
540
Torque Mode
541
Forward or Reverse Enabled
542
Holding Torque Disabled/Belt Free to Move
543
User sets Torque Assistance Setting
544
Motor Controller uses torque setting to assist belt movement
545
Torque Mode Exit
No
Yes
550
Treadmill Stopped

FIG. 15

MOTORIZED TREADMILL WITH MOTOR BRAKING MECHANISM AND METHODS OF OPERATING SAME

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/363,273, entitled "MOTORIZED TREADMILL WITH MOTOR BRAKING MECHANISM AND METHODS OF OPERATING SAME," filed Mar. 25, 2019, which is a continuation of U.S. patent application Ser. No. 15/640,180, entitled "MOTORIZED TREADMILL WITH MOTOR BRAKING MECHANISM AND METHODS OF OPERATING SAME," filed Jun. 30, 2017, which claims the benefit of and priority to U.S. Provisional Patent Application No. 62/357,765, entitled "MOTORIZED TREADMILL WITH MOTOR BRAKING MECHANISM AND METHODS OF OPERATING SAME," filed Jul. 1, 2016, all of which are incorporated herein by reference in their entireties.

This application is related to U.S. patent application Ser. No. 14/941,342, filed Nov. 13, 2015, which is a continuation of U.S. patent application Ser. No. 14/517,478, filed Oct. 17, 2014, which is a continuation of U.S. patent application Ser. No. 13/257,038, filed Sep. 16, 2011, which is a National Stage Entry of International Application No. PCT/US2010/026731, filed Mar. 9, 2010, which claims the priority and benefit of U.S. Provisional Application Ser. No. 61/161,027, filed Mar. 17, 2009, all of which are incorporated herein by reference in their entireties

This application is also related to U.S. application Ser. No. 15/765,681, filed Apr. 3, 2018, which is a National Stage Entry of International Application No. PCT/US2016/055572, filed Oct. 5, 2016, which claims the benefit of and priority to U.S. Patent Application No. 62/237,990, filed Oct. 6, 2015, which is related to U.S. patent application Ser. No. 14/832,708, filed Aug. 21, 2015, which claims the benefit of priority as a continuation of U.S. patent Applicant Ser. No. 14/076,912, filed Nov. 11, 2013, which is a continuation of U.S. patent application Ser. No. 13/235,065, filed Sep. 16, 2011, which is a continuation-in-part of prior international Application No. PCT/US10/27543, filed Mar. 16, 2010, which claims priority to U.S. Provisional Application Ser. No. 61/161,027, filed Mar. 17, 2009, all of which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

The present disclosure relates to treadmills. More particularly, the present disclosure relates to motorized treadmills.

BACKGROUND

Treadmills enable a person to walk, jog, or run for a relatively long distance in a limited space. Treadmills can be used for physical fitness, athlete training and therapeutic uses for the treatment of medical conditions. It should be noted that throughout this document, the term "run" and variations thereof (e.g., running, etc.) in any context is intended to include all substantially linear locomotion by a person. Examples of this linear locomotion include, but are not limited to, jogging, walking, skipping, scampering, sprinting, dashing, hopping, galloping, side stepping, shuffling etc. The bulk of the discussion herein is focused on training and physical fitness, but persons skilled in the art

will understand that all of the structures and methods described herein are equally applicable in a medical therapeutic applications.

A person running generates force to propel themselves in a desired direction. To simplify this discussion, the desired direction will be designated as the forward direction. As the person's feet contact the ground (or other surface), their muscles contract and extend to apply a force to the ground that is directed generally rearward (i.e., has a vector direction substantially opposite the direction they desire to move). Keeping with Newton's third law of motion, the ground resists this rearwardly directed force from the person, resulting in the person moving forward relative to the ground at a speed related to the force they are creating. While the prior discussion relates solely to movement in the forward direction, persons skilled in the art will understand that this can mean movement in any direction, for example side to side, backward/reverse, any desired direction.

To counteract the force created by the treadmill user so that the user stays in a relatively static fore and aft position on the treadmill, a running belt of a treadmill is driven or rotated (e.g., by a motor). Thus, in operation, the running belt moves at substantially the same speed as the user, but in the opposite direction. In this way, the user remains in substantially the same relative position along the treadmill while running.

SUMMARY

One embodiment relates to a treadmill. The treadmill includes a running belt defining a non-planar running surface, and a motor operatively coupled to the running belt. According to one configuration, the treadmill is operable in plurality of operating modes to control a user experience.

Another embodiment relates to a treadmill. The treadmill includes a running belt defining a substantially planar running surface, and a motor operatively coupled to the running belt. According to one configuration, the treadmill is operable in plurality of operating modes.

Still another embodiment relates to of operating a motorized treadmill. The method includes: providing a treadmill having a running belt defining a non-planar running surface and a motor coupled to the running belt, the motor operable in a first operating mode, a second operating mode, a third operating mode, and a fourth operating mode; responsive to receiving an indication to operate the treadmill in a first operating mode, causing the motor to disengage from the running belt such that rotation of the running belt is caused solely by a user of the motorized treadmill; responsive to receiving an indication to operate the treadmill in a second operating mode, causing the motor to selectively drive rotation of the running belt in a first rotational direction and in a second rotational directional, the second rotational direction opposite the first rotational direction; responsive to receiving an indication to operate the treadmill in a third operating mode, causing the motor to output a holding torque at a predefined threshold speed value; and responsive to receiving an indication to operate the treadmill in a fourth operating mode, causing the motor to output a torque assist force, the torque assist force configured to help rotate the running belt in addition to a force applied by the user to the running belt.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a treadmill having a non-planar running surface, according to an exemplary embodiment.

FIG. **2** is a perspective view of the treadmill of FIG. **1** with most of the coverings removed, according to an exemplary embodiment.

FIG. **3** is another perspective view of the treadmill of FIG. **1** with most of the coverings removed, according to an exemplary embodiment.

FIG. **4** is a perspective view of the motor system of the treadmill of FIG. **1**, according to an exemplary embodiment.

FIG. **5** is an exploded assembly view of the motor system of the treadmill of FIG. **1**, according to an exemplary embodiment.

FIG. **6** is a perspective view of a treadmill having a substantially planar running surface, according to an exemplary embodiment.

FIG. **7** is a perspective view of the treadmill of FIG. **6** with most of the coverings removed, according to an exemplary embodiment.

FIG. **8** is another perspective view of the treadmill of FIG. **1** with most of the coverings removed as well as the running belt, according to an exemplary embodiment.

FIG. **9** is a top view of the treadmill of FIG. **8**, according to an exemplary embodiment.

FIG. **10** is an exploded assembly perspective view of the motor system of the treadmill of FIG. **6** with most of the coverings removed, according to an exemplary embodiment.

FIG. **11** is a top perspective view of the component view of the treadmill in FIG. **10**, according to an exemplary embodiment.

FIG. **12** is a perspective view of the motor system of the treadmill of FIG. **6**, according to an exemplary embodiment.

FIG. **13** is an exploded assembly view of the motor system of FIG. **12**, according to an exemplary embodiment.

FIG. **14** is an electrical schematic diagram for the treadmill of FIG. **1** or the treadmill of FIG. **6**, according to an exemplary embodiment.

FIG. **15** is a flow diagram of operating the treadmill of FIG. **1** or the treadmill of FIG. **6** using the electrical schematic diagram of FIG. **14**, according to an exemplary embodiment.

DETAILED DESCRIPTION

Referring to the Figures generally, a motorized or powered treadmill operable in a plurality of modes is disclosed according to various embodiments herein. The motorized treadmill includes a controller communicably coupled to a motor that is operatively coupled to a running belt, which defines a running surface upon which a user a may run. According to the present disclosure, the controller is structured to control or manage operation of the motor to enable operation of the treadmill in four operating modes: a non-motorized mode, a motorized mode, a brake mode, and a torque mode. In the non-motorized mode, the controller disables a holding torque of the motor to thereby allow the running belt to substantially freely rotate (i.e., the motor provides no or little resistance to the rotation or movement of the running belt such that the running belt moves substantially freely). In this regard, the treadmill may operate in a similar manner to a manually-powered treadmill (i.e., motor-less treadmill) where the speed of the running belt is dictated by a variety of factors including the gait speed of the user. In the motorized mode, the user controls the speed of the running belt by providing input to the controller and the controller in turn implements the input from the user to establish the desired running belt speed with the treadmill. For example, the user may provide a designation of 6.5 miles-per-hour (MPH), which the controller then directs the motor to cause the running belt to rotate at 6.5 MPH. In the brake mode, the controller is structured to control the motor to apply a braking force (i.e., holding torque) that resists rotational movement of the running belt caused by the user. In this regard, the user has to "fight" or "push" through the resistance exerted by the motor to cause the running belt to rotate. In the torque mode, the controller causes the motor to implement a user-defined torque setting to provide an assistive force to, in turn, cause the running belt to rotate relatively easier than, for example, in the non-motorized or brake modes of operation. In one embodiment, the treadmill may be structured as a substantially planar treadmill whereby a running belt having a running surface upon which a user may run is substantially planar in nature. In another embodiment, the treadmill is structured as a non-planar or curved treadmill whereby a running belt running surface upon which a user may run is non-planar in nature (see, e.g., FIG. **1** herein).

Beneficially, the modes of operation enable the use of a single treadmill to be adapted for use with a variety of workout types and a variety of users of varying fitness levels. For example, users who desire weight training may find the brake mode of operation desirable due to the relatively high-resistance, strength conditioning aspect of this mode of operation (i.e., the pushing or pulling of the belt to overcome a braking force exerted on the running belt). As another example, users who desire aerobic, running exercises may like the ability to manually control the speed via the non-motorized mode of operation or to run at a certain speed for a certain amount of time via the motorized mode operation. As still another example, users who may be rehabilitating an injury, just getting into a workout routine, or who simply want assistance may find the torque mode of operation desirable. In this regard, users of a variety of skills and desires may each find the treadmill of the present disclosure appealing. In this regard and advantageously, the treadmill of the present disclosure may alleviate the need for multiple types of fitness or rehabilitation equipment because of the types of rehabilitation routines or exercises that may be possible due to the modes of operation described herein. These and other features and benefits of the present disclosure are described more fully herein below.

As mentioned above, the motorized treadmill may be structured as a planar treadmill or as a non-planar treadmill. In this regard, FIGS. **1-5** depict a non-planar treadmill while FIGS. **6-13** depict a planar treadmill, according to various embodiments. Each of these treadmill embodiments are firstly described before turning to the operational modes of the treadmill.

Accordingly, referring collectively now to FIGS. **1-5**, a motorized non-planar treadmill **10** is shown according to an example embodiment. As shown, the treadmill **10** includes a base **12**, a handrail **14** mounted or coupled to the base **12**, a display device **16** coupled to the handrail **14**, a running belt **30** that extends substantially longitudinally along a longitudinal axis **18**, a pair of side panels **40** and **42** (e.g., covers, shrouds, etc.) that are provided on the right and left side of the base **12**, a pair of rearward positioned feet **50** (i.e., proximate the rear end **22**), a pair of forward positioned feet **52** (i.e., proximate the front end **20**), and a pair of wheels **54** (e.g., casters, rollers, etc.) positioned proximate the front end **20**). The longitudinal axis **18** extends generally between a front end **20** and a rear end **22** of the treadmill **10**; more specifically, the longitudinal axis **18** extends generally between the centerlines of a front shaft and a rear shaft, which will be discussed in more detail below. The side panels **40** and **42** may shield the user from the components or moving parts of the treadmill **10**. The base **12** is supported by multiple support feet **50** and **52**, while the pair of wheels **54** enable a user to grip a handle (not shown) of the base **12** to relatively easily move the treadmill **10**. In use, the wheels **54** of the treadmill **10** are supported above a support surface; the wheels **54** may contact the ground to thereby permit the user to easily roll the entire treadmill **10** when desired. It should be noted that the left and right-hand sides of the treadmill and various components thereof are defined from the perspective of a forward-facing user standing on the running surface of the treadmill **10**.

A number of devices, both mechanical and electrical, may be used in conjunction with or in cooperation with a treadmill **10**. FIG. **1**, for example, shows a display device **16** adapted to calculate and display performance data relating to operation of the treadmill **10** according to an exemplary embodiment. The display device **16** may include any type of display device including, but not limited to, touchscreen display devices, physical input devices in combination with a screen, and so on. The display device **16** may include an integrated power source (e.g., a battery), or be electrically coupleable to an external power source (e.g., via an electrical cord that may be plugged into a wall outlet). The feedback and data performance analysis from the display may include, but are not limited to, speed, time, distance, calories burned, heart rate, etc. According to other exemplary embodiments, other displays, cup holders, cargo nets, heart rate grips, arm exercisers, TV mounting devices, user worktops, and/or other devices may be incorporated into the treadmill. Further and as shown, the display device **16** may include a plurality of input devices (e.g., buttons, switches, etc.) that enable a user to provide instructions to the treadmill **10** and to control the operation thereof.

As shown in more detail in FIGS. **2-3**, the base **12** includes a frame **60** which is an assembly of elements such as longitudinally-extending, opposing side members, shown as a right-hand side member **61** and a left hand side member **62** and one or more lateral or cross-members **63** extending between and structurally coupling the side members **61** and **62**. The frame **60** is adapted to support a front shaft assembly **70** positioned near a front end **20** of the frame **60**, a rear shaft assembly **80** positioned near the rear end **22** of frame **60**, a plurality of bearings **90** coupled to and extending generally longitudinally along the right side member **61** of the frame **60**, a plurality of bearings **91** coupled to and extending generally longitudinally along the left-hand side member **62** of the frame **60**. The pluralities of bearings **90**, **91** are substantially opposite each other about the longitudinal axis **18**, and a tension assembly **100** coupled to the frame **60**. Each of these components is described herein below.

The front shaft assembly **70** includes a pair of front running belt pulleys **72** interconnected with, and preferably directly mounted to, a shaft **71**, while the rear shaft assembly **80** includes a pair of rear running belt pulleys **82** interconnected with, and preferably directly mounted to, a shaft **81**. In operation, multiple bearing assemblies **75** may rotationally couple the front shaft assembly **70** and rear shaft assembly **80** to the frame **60**. The bearing assemblies **75** may be structured as any type of bearing assembly configured to support and enable rotation of the shaft assemblies relative to the frame **60** (e.g., thrust bearings, etc.). The front and rear running belt pulleys **72**, **82** are configured to facilitate movement/rotation of the running belt **30**. As the front and rear running belt pulleys **72**, **82** are preferably fixed relative to shafts **71** and **81**, respectively, rotation of the front and rear running belt pulleys **72**, **82** causes the shafts **71**, **81** to rotate in the same direction. The front and rear running belt pulleys **72**, **82** may be formed of any material sufficiently rigid and durable to maintain shape under load. According to one embodiment, the material is relatively lightweight so as to reduce the inertia of the pulleys **72**, **82**. The pulleys **72**, **82** may be formed of any material having one or more of these characteristics (e.g., metal, ceramic, composite, plastic, etc.). According to the exemplary embodiment shown, the front and rear running belt pulleys **72**, **82** are formed of a composite-based material, such as a glass-filled nylon, for example, Grivory® GV-5H Black 9915 Nylon Copolymer available from EMS-GRIVORY of Sumter, S.C. 29151, which may save cost and reduce the weight of the pulleys **72**, **82** relative to metal pulleys. To prevent a static charge due to operation of the treadmill **10** from building on a pulley **72**, **82** formed of electrically insulative materials (e.g., plastic, composite, etc.), an antistatic additive, for example Antistat 10124 from Nexus Resin Group of Mystic, Conn. 06355, may be may be blended with the GV-5H material. Alternatively, the pulleys **72**, **82** may be formed of a relatively heavy or high mass material (e.g., metal, ceramic, composite, etc.) if it is desired to create a support structure which has a relatively high inertia as the user generates rotation of the running belt.

The pluralities of bearings **90**, **91** are attached or coupled to the frame **10** and structured to support or at least partially support the running belt **30** and to facilitate movement thereof. In this regard, the pluralities of bearings **90**, **91** may be arranged to facilitate a desired shape or contour of the running surface **32** of the running belt **30**. More particularly, the pluralities of bearings **90**, **91** may be arranged in a desired shape or contour of the running surface **32** due to how the pluralities of bearings **90**, **91** are coupled to the frame **60** (e.g., in such a way to form a non-planar profile). Accordingly, the running surface **30** assumes a shape that substantially corresponds to the shape of the profile of the pluralities of the bearings **90**, **91**. The bearings **90**, **91** are configured to rotate to thereby decrease the friction experienced by the running belt **30** as the belt moves or rotates relative to the frame **10**. The tension assembly **100** may be structured to selectively adjust a position of the rear shaft assembly **80** to add, reduce, and generally control a tension applied to the belt **30**. An exemplary structure of the bearings **90**, **91** and tension assembly **100**, components that may be included therewith, and arrangements therefor (e.g., relative positions on the treadmill) is described in U.S. patent application Ser. No. 15/765,681, filed Apr. 3, 2018, which as mentioned above is incorporated herein by reference in its entirety as well as the other listed related applications. In this regard, the tension assembly may cooperate with a slot (e.g., slot 91 of U.S. patent application Ser. No. 15/765,681) that is curve-shaped, linear-shaped, or non-linear shaped.

As shown, the running belt **30** is disposed about the front and rear running belt pulleys **72**, **82**, and at least partially supported by at least some of the pluralities of bearings **90**, **91**. The running belt **30** includes a plurality of slats **31** and defines a non-planar running surface **32** (e.g., curved running surface); hence, the "non-planar" treadmill **10**. An example structure of the slats **31** and shape of the running surface **32** is described in U.S. patent application Ser. No. 15/765,681, filed Apr. 3, 2018, which as mentioned above is incorporated herein by reference in its entirety as well as the other listed related applications.

As also shown, the treadmill **10** according to the present disclosure includes a motor system **150**. The motor system **150** is structured to selectively provide and not provide power or rotational force to the running belt **30** to operate the treadmill **10** in accordance with the non-motorized mode of operation, motorized mode of operation, brake mode of operation, and torque mode of operation. As shown, the motor system **150** includes a motor **151** attached or coupled to the frame **60** (particularly, the left-hand side member **62**) by a bracket **76** (e.g., housing, support member, etc.). The motor **151** includes an output shaft **152**, which is rotatably coupled to a drive pulley **153** that is rotatably coupled to a driven pulley **154** by a motor belt **155**. As shown, the motor system **150** is in cooperation with the front shaft assembly **70**. In particular, the driven pulley **154** is interconnected with (e.g., directly mounted on) the front shaft **71**, such that rotation of the driven pulley **154** causes rotation of the front shaft **71** (and, in turn, the front running belt pulleys **72**). However, in other embodiments, the motor system **150** may be in cooperation with the rear shaft assembly (e.g., the driven pulley may be rotationally coupled to the rear shaft) and/or multiple motor systems may be included whereby the motor systems are included in various positions with various connections to various components of the treadmill. While the present invention uses a motor belt **155** to translate the drive force/braking action of the motor to the running belt, it is to be understood that any conventional means for interconnecting the motor to the running belt including gears, chains, and the like may be used in addition to or in place of the motor belt **155**.

The motor **151** may be structured as any type of motor that may be used to selectively power (e.g., impart force to or otherwise drive rotation of) the running belt **30**. In this regard, the motor **151** may be an alternating current (AC) motor or a direct current (DC) motor and be of any power rating desired. In one embodiment, the motor **151** is structured as brushless DC motor in order to be able to selectively provide a driving force which is useable in the motorized mode and a holding torque, which is useable in the brake mode of operation (described in more detail herein below). Further, the motor **151** may receive electrical power from an external source (e.g., from a wall outlet) or from a power source integrated into the treadmill, such as a battery. Additionally, the motor **151** may be solely a motor or be a motor/generator combination unit (i.e., capable of generating electricity). Similarly, the drive pulley **153**, driven pulley **154**, and belt **155** may be structured as any type of pulley and belt combination. For example, in one embodiment, the belt **155** may be structured as a toothed belt. In another example, the belt **155** may be structured as a v-shaped belt. In yet another example, the belt **155** may be structured as a substantially smooth belt. In each configuration, the configuration of the pulleys **153**, **154** may correspond (e.g., a v-shaped pulley to correspond with a v-shaped belt) with the structure of the belt **155**. Moreover and as shown, the drive pulley **153** is of a relatively larger size (e.g., diameter) than the driven pulley **154**. In another embodiment, the driven pulley **154** is of a relatively larger size (e.g., diameter) than the drive pulley **153**. In still other embodiments, the driven pulley **154** and drive pulley **153** are of substantially similar sizes (e.g., diameters). Differing diameters of the drive pulley **153** to driven pulley **154** differs the speed differential between the two pulleys, which may be used to achieve a desired speed ratio for the treadmill **10**. Thus, those of ordinary skill in the art will readily recognize and appreciate the wide variety of structural configurations of the motor system **150**, with all such variations intended to fall within the scope of the present disclosure.

Before turning to operation of the motor system **150**, as mentioned above, the systems and methods described herein may also be implemented with planar or substantially planar motorized treadmills. Therefore, turning now to FIGS. **6-13**, a planar motorized treadmill **200** is shown according to various example embodiments. The planar motorized treadmill **200** may be substantially similar as the non-planar motorized treadmill **10** except that the running surface of the treadmill **200** is substantially planar in nature (e.g., flat, not-curved, etc.). While the incline of the running surface may change with either the treadmill **10** or treadmill **200**, the characteristic planar feature of the treadmill **200** remains constant. Thus, to ease explanation of the treadmill **200**, similar reference numbers are used with FIGS. **6-13** as were used in FIGS. **1-5** with the treadmill **10** except with the prefix "2" (with the notable exception of reference number **200** being used from the treadmill of FIGS. **6-13** compared to the reference number **10** for the treadmill of FIGS. **1-5**). In this regard, similar reference numbers are used to denote similar components unless context indicates otherwise or unless explicitly described otherwise.

In this regard and referring collectively to FIGS. **6-13**, the planar motorized treadmill **200** includes a base **212**, a handrail **214** mounted or coupled to the base **212**, a display device **216** coupled to the handrail **214**, a running belt **230** that extends substantially longitudinally along a longitudinal axis **218**, a pair of side panels **240** and **242** (e.g., covers, shrouds, etc.) that are provided on the right and left side of the base **212**, and a frame **260** including a right-hand side member **261** and a left-hand side member **262** disposed substantially longitudinally opposite the right-hand side member **261**. One or more cross-members, such as cross-members **263**, may be used to join, couple, or otherwise connect the right-hand and left-hand side members **261**, **262** together. The longitudinal axis **218** extends generally between a front end **220** and a rear end **222** of the treadmill **200**. The side panels **240** and **242** may shield the user from the components or moving parts of the treadmill **200**. Like the treadmill **10**, it should be noted that the left and right-hand sides of the treadmill and various components thereof are defined from the perspective of a forward-facing user standing on the running surface of the treadmill **200**. It should also be noted that similar support feet and wheels as described herein with respect to the treadmill **10** and in the related applications under the cross-reference to related applications section may also be included with the treadmill **200**.

Like the treadmill **10**, the treadmill **200** includes a pair of front running belt pulleys **272** coupled to, and preferably directly mounted to, a shaft **271**, and a rear shaft assembly **280** includes a pair of rear running belt pulleys **282** coupled to, and preferably directly mounted to, a shaft **281**. The front and rear running belt pulleys **272**, **282** are configured to facilitate rotational movement of the running belt **230**, and may be rotationally coupled to the frame **260** by multiple bearing assemblies **275**. As the front and rear running belt pulleys **272**, **282** are preferably fixed relative to shafts **271** and **281**, respectively, rotation of the front and rear running belt pulleys **272**, **282** causes the shafts **271**, **281** to rotate in the same direction.

As also shown, the treadmill **200** may include a plurality of bearings **290** coupled to and extending longitudinally the right side member **261** of the frame **260**, and a plurality of bearings **292** coupled to and extending longitudinally along the left-hand side member **262** of the frame **260** such that the pluralities of bearings **290**, **291** are substantially opposite each other about the longitudinal axis **218**. Relative to the pluralities of bearings **290**, **291**, the pluralities of bearings **290**, **291** are arranged in a substantially planar configuration to at least partly support the running belt **230** in the substantially planar orientation/configuration.

As shown, the running belt **230** is disposed about the front and rear running belt pulleys **272**, **282**, and at least partially supported by the bearings **290**, **291**. The running belt **230** includes a plurality of slats **231** and defines a planar or substantially planar running surface **232** (e.g., non-curved running surface); hence, the "planar" treadmill **10**. An example structure of the slats **231** is described in U.S. patent application Ser. No. 15/765,681, filed Apr. 3, 2018, which as mentioned above is incorporated herein by reference in its entirety as well as the other listed related applications. However, in other embodiments, the running belt **230** and running belt **30** may be constructed as an endless belt, also referred to as a closed-loop treadmill or running belt (e.g., a non-slat embodiment). As also shown, the running belt **230** includes an endless belt **233**, which interfaces with or engages with a front running belt and a rear running belt pulley. Another endless belt (not shown) engages with the other front running belt pulley and rear running belt pulley. The endless belts **233** may be supported by the plurality of bearings **290**, **291**, respectively. Further details regarding example configurations of the endless belts **233** are provided in U.S. patent application Ser. No. 14/832,708 and related applications, which as mentioned before are incorporated herein by reference in their entireties. It should be understood that while not shown, the treadmill may incorporate an alternative to the slat belt such as an endless belt, like endless belt and described under the related applications may also be used with the running belt **30** of the non-planar treadmill **10**.

Similar to the motorized treadmill **10**, the treadmill **200** is motorized and includes a motor system **350**. The motor system **350** is structured to selectively provide power, to not provide power, or to provide braking to resist rotational movement of the running belt **230** as the treadmill **200** operates in the non-motorized mode of operation, motorized mode of operation, brake mode of operation, and torque mode of operation. As shown, the motor system **350** includes a motor **351** attached or coupled to the frame **260** (particularly, the left-hand side member **262**) by a bracket **276** (e.g., housing, support member, etc.) and has an output shaft **352**, a drive pulley **353**, and a driven pulley **354** coupled to the drive pulley **353** by a motor belt **355**. As shown, the motor system **350** is in cooperation with the rear shaft assembly **280**. In particular, the driven pulley **354** is interconnected with (e.g., directly mounted on) the rear shaft **281**, such that rotation of the driven pulley **354** causes rotation of the rear shaft **281** (and, in turn, the rear running belt pulleys **282**). However, in other embodiments, the motor system **350** may be in cooperation with the front shaft assembly (e.g., the driven pulley may be rotationally coupled to the rear shaft) and/or multiple motor systems may be included whereby the motor systems are included with the treadmill.

Like the motor **151**, the motor **351** may be structured as any type of motor that may be used to selectively power (e.g., impart force to or otherwise drive rotation of) the running belt **230**. In one embodiment, the motor **351** is structured as brushless DC motor in order to be able to selectively provide resistance to rotation of the running belt in the form of a holding torque, which is useable in the brake mode of operation (described in more detail herein below). In this regard, the motor **351** may be an alternating current (AC) motor or a direct current (DC) motor and be of any power rating desired. Thus, the motor **351** may receive electrical power from an external source (e.g., from a wall outlet) or from a power source integrated into or included within the treadmill, such as a battery. Further, the motor **351** may be solely a motor or be a motor/generator combination unit. Similarly, the drive pulley **353**, driven pulley **354**, and belt **355** may be structured as any type of pulley and belt combination. For example, in one embodiment and as shown, the belt **355** may be structured as a toothed belt. In another example, the belt may be structured as a v-shaped belt. In yet another example, the belt may be structured as a substantially smooth belt. In each configuration, the configuration of the pulleys **353**, **354** may correspond to that of the belt **355** (e.g., v-shaped pulley to correspond with a v-shaped belt). For example and as shown, the pulleys **353**, **354** may be toothed to mesh or engage with the toothed belt **355**. Moreover and as shown, the drive pulley **353** is of a relatively smaller size (e.g., diameter) than the driven pulley **354**. In another embodiments, the driven pulley **354** is of a relatively greater diameter than the drive pulley **353**. In still other embodiments, the driven pulley **354** and drive pulley **353** are of substantially similar diameters. Differing diameters of the drive pulley **353** to driven pulley **354** differs the speed differential between the two pulleys, which may be used to achieve a desired speed ratio for the treadmill **10**. Thus, those of ordinary skill in the art will readily recognize and appreciate the wide variety of structural configurations of the motor system **350**, with all such variations intended to fall within the scope of the present disclosure.

Referring now to FIG. **14**, a schematic diagram of an electrical system **400** useable with either treadmill **10** or treadmill **200** is shown according to an example embodiment. The electrical system **400** may be structured to control various components of the treadmill **10** and treadmill **200**, track and store data regarding operation of the treadmill **10** and treadmill **200**, enable the exchange of data or information between various components of the treadmill **10** and treadmill **200** (e.g., heart rate data acquired from the handrails or wirelessly), and/or otherwise control or manage the providing of electrical power to one or more components of the treadmill **10** or treadmill **200**. Because the system **400** is useable with either treadmill **10** or treadmill **200**, reference may be made to various components of the treadmill **10** or **200** to aid explanation. As shown, the system **400** is electrically configurable to be useable with 120 VAC or 230 VAC line voltage, as shown with input power systems **402** and **404** respectively. The input power systems **402**, **404** may include an electrical cord that is electrically adapted to plug-into a wall outlet (or other electricity providing source) for receiving 120 VAC or 230 VAC, respectively. The input power systems **402**, **404** are shown to include various switches, relays, transformers, and filters to modify, manage, or otherwise control the electrical power received from a power source (e.g., wall outlet). In other embodiments, only one of the input power systems **402** or **404** may be included with the treadmill. In the example shown, an input power system **410** is electrically coupleable to a 120 VAC power source (e.g., an American wall outlet) to receive 120 VAC power. The received power may be useable to drive or power one or more components of the treadmill **10** or treadmill **200**.

As also shown, the system **400** includes a DC power supply **412**, a television circuit **420**, a computer circuit **425**, a display board **430**, a motor controller **440**, and a controller **450** among various other components. The DC power supply **412** may be structured as any DC power supply and be independent from the AC power source (e.g., from input power system **410**) or used with the AC power source by using, e.g., a rectifier to convert the AC voltage to DC voltage, like shown in FIG. **14**. The DC power supply **412** may be used to power one or more DC-powered electronics, such as the television circuit **420** and computer circuit **425**. The television circuit **420** is structured to provide television, over the air or through any other auxiliary means (e.g., cable or satellite), to users of the treadmill **10** or **200**. In this regard, the television circuit **420** is shown to include a television **421** (e.g., display device, monitor, etc.) operatively coupled to a keypad controller **422** (e.g., remote, etc.), whereby the keypad controller **422** enables a user to control the television **421**. In one embodiment, the television **421** is included with the treadmill **10** or **200**. In another embodiment, the television **421** is a separate component relative to the treadmill **10** or **200**, such that the television circuit **420** includes communication circuitry for coupling to the television **421**. In operation, the keypad controller **422** may be disposed on the handrail **14** or **214**, or any other convenient location, that enables a user to control the television **421**. The computer circuit **425** is shown to include a computer **426**. The computer circuit **425** is structured to facilitate the communicable coupling of the treadmill **10** or **200** to one or more computer electronics (e.g., smartphone, tablet computer, heartrate monitor, fitness tracking device, etc.) to enable the exchange of information between the one or more computer electronics and the computer circuit **425**. In this regard, computer circuit **425** may include any type of electrical coupling devices or components (e.g., wireless transceivers such as a Bluetooth® transceiver, NFC transceiver, and the like, wired transceiver such as an Ethernet port or USB port, and/or any combination thereof). It should be understood that the computer circuit **425** and television circuit **420** may include any other additional and/or different components for performing the activities described herein (e.g., filters, a memory device or other storage device, one or more processors, etc.). It should also be understood that the television circuit **420** and computer circuit **425** are optional components, which may be selectively included with the treadmill **10** or treadmill **200** based on, for example, a model of the treadmill or a desire of the producer/manufacturer.

The display board **430** may be structured to enable the reception of an input from a user of the treadmill **10** or **200** and to provide outputs to the user (e.g., heart rate, distance, time duration, set speed, incline setting, resistance setting for brake operation mode, etc.). Accordingly, the display board **430** may be included with display device **16** or **216**. As shown, the display board **430** is communicably and operatively coupled to a plurality of sensors and other input devices, shown as an emergency stop (e-stop) magnet **431**, a heart rate contact **432**, and a handrail switch assembly **433**. The e-stop magnet **431** is structured to instantly or nearly instantly stop the motor **151**, **351** of the treadmill **10** or **200** or, alternatively, enable power to be provided from the motor **151**, **351** to the running belt **30**, **230**. In operation, the e-stop magnet may be selectively engageable (e.g., via magnetic force) with a magnet that is tethered to the treadmill **10**, **200**. When the magnetic is in contact with the e-stop magnet **431**, the circuit may be closed to enable the motor **151**, **351** to selectively provide power to, e.g., drive the running belt **30**, **230**. When the magnet is not in contact with the e-stop magnet **431**, the motor **151**, **351** may be disabled (e.g., prevented from driving the running belt). The heart rate contacts **432** may be structured to acquire data indicative of a heart rate or pulse of a user of the treadmill **10**, **200**. The hart rate contacts **432** may be disposed on the handrail **14**, **214** or in any other desired location on the treadmill **10**, **200**. The handrail switch assembly **433** includes various switches, buttons, and the like disposed on the handrail **14**, **214** that are structured to enable a user to provide one or more inputs to the treadmill **10**, **200**. For example, the handrail switch assembly **433** may enable a reception of a mode designation input (e.g., motorized mode, non-motorized mode, brake mode, or torque mode). As another example, the handrail switch assembly **433** may enable a reception of a speed designation for motorized mode (e.g., 7 MPH, etc.). As another example, the handrail switch assembly **433** may enable reception an incline setting (e.g., a setting that affects the incline of the treadmill relative to a support surface). As still another example, the handrail switch assembly **433** may enable reception of a resistance level in brake mode that controls the resistance a user experiences rotating the running belt **30**, **230**. As yet another example, the handrail switch assembly **433** may enable reception of a torque assist setting that controls the assistance force provided by the motor **151**, **351** in torque mode. As still yet another example, the handrail switch assembly **433** may enable a user to observe tracked data regarding operation of the treadmill **10**, **200** (e.g., heart rate, speed, duration, etc.). It should be understood that the handrail switch assembly **433** may include additional functionality beyond that mentioned above and herein, with all such additional or different functionality intended to fall within the scope of the present disclosure (e.g., turn the treadmill on or off, etc.). Further, in certain embodiments, some of the functionalities described above may be implemented via the display device **16** or **216** rather than on buttons, switches, input devices and the like disposed on the handrail **14** or **214**.

As shown, the display board **430** is communicably coupled to the controller **450**, which is communicably coupled to the motor controller **440**, which is operatively coupled to the motor **441**. In this regard, the controller **450** may serve as an intermediary between the motor controller **440** and the display board **430**. In operation, the motor controller **440** may be structured to control operation of the motor **441**. The motor **441** may be structured as the motor **151** when used with the treadmill **10**. However, when used with the treadmill **200**, the motor **441** may be structured as the motor **351**. Thus, the motor **441** designation is intended to be generic to both treadmill **10** and **200** implementations. While the display board **430** and motor controller **440** are shown as separate components from the controller **450**, this is for exemplary purposes only. In other embodiments, one, both, or portions thereof of the display board **430** and motor controller **440** may be included with the controller **450**. In this regard and because the motor controller **440** may be included with the controller **450**, or because the controller **450** may provide one or more instructions to the motor controller **440** to control operation of the motor **441**, or because the controller **450** may directly control the motor **441** (e.g., a direct instruction to the motor **441** from the controller **450**), explanation herein may be in regard to the controller **450** performing various activities. However and based on the foregoing, it should be understood that execution of such activities may be direct (e.g., the controller **450** directly controlling the motor **441**) or indirect (e.g., the controller **450** providing a command to the motor **440** to control the motor **441**) with all such variations intended to fall within the scope of the present disclosure.

Accordingly and among various activities, the controller **450** may be structured to control implementation and operation of the operating modes for the treadmill **10** or treadmill **200**. To accomplish these activities, the controller **450** may be structured as a variety of different types of controllers with one or more of a variety of components. For example, the controller **450** may include one or more processing circuits including one or more processors communicably coupled to one or more memory devices. The one or more processors may be implemented as any type of processor including an application specific integrated circuit (ASIC), one or more field programmable gate arrays (FPGAs), a digital signal processor (DSP), a group of processing components, or other suitable electronic processing components. The one or more memory devices (e.g., NVRAM, RAM, ROM, Flash Memory, hard disk storage, etc.) may store data and/or computer code for facilitating the various processes described herein. Thus, the one or more memory devices may be communicably connected to the one or more processors and provide computer code or instructions for executing the processes described in regard to the controller **450** herein. Moreover, the one or more memory devices may be or include tangible, non-transient volatile memory or non-volatile memory. Accordingly, the one or more memory devices may include database components, object code components, script components, or any other type of information structure for supporting the various activities and information structures described herein.

One such example activity of the controller **450** includes adjustment of a relative incline of the treadmill **10** or treadmill **200**. For example, and as shown, the controller **450** is coupled to an incline motor **460**. The incline motor **460** is structured to adjust a relative incline of the treadmill **10** or treadmill **200** by moving, e.g., an extension of the support feet from the treadmill **10** or treadmill **200**. An example structure and configuration of the incline motor **460** and various related components and the functionalities associated therewith is described in U.S. patent application Ser. No. 14/832,708, which as mentioned above is incorporated herein by reference in its entirety along with the various other related applications. Further and as also shown, the controller **450** may be communicably to one or more sensors, such as incline feedback sensor and elevation limit switch that may define boundaries of the allowable relative incline for the treadmill **10** or treadmill **200**.

As mentioned above and another such example activity of the controller **450** includes implementation of and control of the operating modes of the treadmill **10** and **200** described herein. In this regard and as shown in the example of FIG. **14**, the controller **450** may provide instructions, directly or indirectly (e.g., via the motor controller **440**) to control and implement the various operating modes of the treadmill **10** or treadmill **200**.

Before turning to an example control methodology for selectively controlling implementation of the operating modes as shown in FIG. **15**, it should be understood that the electrical system **400** useable with either the treadmill **10** or treadmill **200** is exemplary only. In other embodiments, more, less, or different components may be included with the electrical system for one or both of the treadmills **10**, **200**. For example, in other embodiments, various additional filtering components may be used that smooth out and reduce noise in the exchange of data among and between the components. In another example, various additional sensors relative to the heart rate contacts **432** may also be implemented, such as a weight sensor structured to acquire data indicative of a weight of a user. Thus, those of ordinary skill in the art will appreciate and recognize that the system **400** is not meant to be limiting as the present disclosure contemplates additional configurations that are intended to fall within the scope of the present disclosure.

Referring now to FIG. **15**, an example control methodology for implementing various operating modes with a motorized treadmill is shown according to an example embodiment. Because the method **500** may be implemented with the treadmill **10** or treadmill **200**, reference may be made to one or more components of the treadmill **10** or **200** to aid explanation.

At process **501**, data indicative of powering a treadmill on is received. In other words, process **501** refers to turning the treadmill **10** or treadmill **200** on. Data indicative of turning the treadmill on may be based on an explicit user input, such as an "ON" button on the handrail switch assembly **433**. Additionally or alternatively, data indicative of turning the treadmill on may be based on a determination of the controller **450**. For example, weight data indicative of a user standing on the treadmill for more than a threshold amount of time may indicate use or potential use of the treadmill and turn the treadmill on. In another example, the user may begin to use the treadmill whereby movement of the running belt **30** or **230** causes the treadmill to turn ON.

At process **502**, a mode selection is received. Upon a powering on of the treadmill **10** or **200**, the display device **16** or **216** presents an option to the user asking them to select in which mode to operate the treadmill **10** or **200**. As mentioned above, the operation modes include: a non-motorized mode, a motorized mode, a brake mode, and a torque mode. As also mentioned above, in the non-motorized mode, the controller **450** disables a holding torque of the motor **151** or **351** to thereby allow the running belt **30** or **230** to substantially freely rotate (i.e., the motor provides no or little resistance to the rotational movement of the running belt). In the motorized mode, the controller **450** receives a running belt **30** or **230** speed designation from a user and implements that running belt speed with the treadmill **10** or **200**. For example, the user may designate 6.5 miles-per-hour (MPH), which the controller **450** then implements with the motor to cause the running belt to rotate at 6.5 MPH. In this regard, the controller **450** may include one or more formulas, algorithms, processes, look-up tables, and the like for converting a user defined speed to a motor **151** or **351** rotational speed. In the brake mode, the controller **450** is structured to control the motor **151** or **351** to apply a braking force that resists rotational movement of the running belt **30** or **230** caused by the user. In this regard, the user has to "fight" or "push" through the resistance exerted by the motor **151** or **351** to cause the running belt **30** or **230** to rotate. The brake mode may be desired by users who want to strength train by increasing the resistance they experience in moving or turning the belt **30** or **230**. In the torque mode, the controller **450** causes the motor **151** or **351** to implement a user-defined torque setting to provide an assistive force for the user to, in turn, cause the running belt **30** or **230** to rotate relatively easier than, for example, in the non-motorized or brake modes of operation. Each of these modes are explained in more detail below.

At process **503**, data regarding a secondary triggering mechanism is received. In one embodiment, the secondary triggering mechanism refers to the e-stop magnet **432**. In this regard, the data received by the controller **450** is indicative of the e-stop magnet **432** being in contact with a magnet to close the loop or circuit to, in turn, enable power output from the motor **151** or **351**. In another embodiment, the triggering mechanism may refer to any other type of additional mechanism, relative to the ON/OFF mechanism of process **501**, to confirm that the user wants to move forward with using the treadmill **10** or treadmill **200**. In other embodiments, process **503** may be omitted from the method **500**.

In response to receiving an indication that the user desires to operate the treadmill **10** or treadmill **200** in the non-motorized operation mode, process **510** is initiated. The non-motorized operation mode includes processes **511-515**, which are explained herein below.

At process **511**, the non-motorized operation mode includes disabling a motor controller. Thus, in this example, the motor controller **441** is a separate component relative to the controller **450**, such that the controller **450** may provide an instruction to the motor controller **440** to disable (e.g., turn off, disengage, etc.). In other embodiments and as mentioned above, the motor controller **440** may be included with the controller **450** such that the controller **450** may selectively disable the motor controller component. In yet other embodiments, the motor controller may be removed from the system and the controller **450** is structured to perform the activities described herein of the motor controller **440**, such that the controller **450** can directly control the motor **151** or **351**. All such variations are intended to fall within the scope of the present disclosure.

At process **512**, a holding torque of the motor is disabled. The "holding torque" refers to the force or torque applied by the motor **151** or **351** to the running belt. When the holding torque or force is disabled, the running belt **30** or **230** is allowed to freely rotate. In this regard, the motor **151** or **351** does not or substantially does not apply a torque to the front shaft assembly **70** of the treadmill **10** or to the rear shaft assembly **280** of the treadmill **200**. In this regard, these shaft assemblies (e.g., the pulleys coupled thereto) may substantially freely rotate without having to overcome a force provided by the motor **151** or **351**.

At process **513**, the running belt is free to rotate. As depicted in process **513**, the running belt **30** or running belt **230** is free to rotate in a forward direction or in a reverse direction. In this regard, the user can operate the treadmill **10** or treadmill **200** in a direction where their strides move them towards the display device **16** or **216** despite remaining substantially longitudinally static due to the movement of the belt (i.e., the forward direction). Or, the user can face away from the display device **16** or **216** and walk, run, jog, etc. away from the display device **16** or **216** (e.g., the user's back faces the display device)(i.e., the reverse direction). For the sake of clarity, the forward direction corresponds with the running belt **30** rotating counterclockwise based on the view point depicted in FIG. **1** while the reverse direction corresponds with the running belt **30** rotating clockwise based on the viewpoint depicted in FIG. **1**. Because the running belt **30** or **230** is free to rotate in each direction, in another embodiment, the user may orient themselves along the longitudinal axis **18** or **218** such that their feet are substantially perpendicularly oriented relative to the display device **16** or **216**. In this case, the user can perform slides or shuffles (e.g., basketball lane slides) in either of the forward and reverse directions. Thus, a wide variety of exercises, rehabilitation exercises, and routines are applicable with the treadmill **10** or treadmill **200** due to the capability of forward and reverse running belt **30** or **230** directional rotation capability. It should be understood that in other embodiments, a one-way directional device, such as explained and described in U.S. patent application Ser. No. 14/832,708 and related applications that as mentioned above are incorporated herein by reference in their entireties may be included with the treadmill **10** or treadmill **200**. In this regard, the one-way directional device (e.g., a one-way bearing) may cooperate with at least one of the front and rear shaft assemblies of the treadmill **10** or treadmill **200** to substantially only permit rotation of at least one of the front and rear shaft assemblies in only one direction (e.g., only the forward direction or only the reverse direction).

At process **514**, a speed value may be provided to the user. The "speed value" refers to a speed that the user is utilizing the treadmill **10** or treadmill **200** at (e.g., 3 MPH, etc.). In this regard, the "speed" may be provided to the display device **16** or **216** to enable the user to see how fast he/she is causing the treadmill **10** or treadmill **200** to be operated in this non-motorized mode of operation. Of course, process **514** can also include the providing of any type of data to the user via the display device **16** or **216** (e.g., a heartrate determination, time duration, an incline of treadmill, etc.). Thus, process **514** is not meant to be limiting to only the providing of speed values.

At process **515**, an exit command is determined to be received. The "exit command" refers to any type of command or instruction received by the treadmill **10** or treadmill **200** that causes the operation mode (in this case, the non-motorized operation mode) to end. For example, a user may provide an explicit instruction via the display device **16** or **216** or the handrail switch assembly **433** ending their workout or injury rehabilitation routine. As another example, a user may simply stop moving, which causes the running belt **30** or **230** to stop moving (because in non-motorized mode of operation the running belt **30** or **230** is driven by the user) and provides an indication after a threshold amount of time that the user has ended use of the treadmill **10** or **200**. If the exit command is determined to be received by the controller **450**, the treadmill **10** or **200** is stopped (process **550**). This may include turning various powered electronics off (e.g., display devices) to conserve energy. If the exit command is determined to not be received by the controller **450**, the treadmill **10** or **200** may continue operating in the designated mode of operation.

In response to receiving an indication that the user desires to operate the treadmill **10** or treadmill **200** in the motorized operation mode, process **520** is initiated. The motorized operation mode includes processes **521-525**, which are explained herein below.

At process **521**, a forward or reverse belt rotation mode designation is received. As mentioned above and in this embodiment, the running belt **30** or **230** is rotatable in either the counterclockwise direction (i.e., forward direction) or clockwise direction (i.e., reverse direction)(based on the viewpoint of FIG. **1**). In this regard and because this mode of operation corresponds with the motor **151** or **351** at least partly driving the running belt **30** or **230**, the motor **151** or **351** is structured to be able to rotate in each direction. However, in other embodiments (e.g., when a one-way directional device is utilized) when the running belt **30** or **230** is only capable of rotating one direction, a different type of motor may be used that only corresponds with that rotation direction. Thus, a variety of configurations are possible with all such configurations intended to fall within the scope of the present disclosure. Upon designation of the forward or reverse belt rotation direction, the controller **450** provides a command to cause or eventually cause the motor **151** or **351** to operate in a direction that corresponds with the chosen or designated belt rotation direction.

At process **522**, a speed selection is received. In this regard, the controller **450**, via the display device **16** or **216** and/or through the handrail switch assembly **433**, receives an indication of a desired speed of the running belt **30** or **230** in the designated direction of process **521** (e.g., 5 MPH, etc.). This selection may correspond with the controller **450** directly or indirectly through the motor controller **440** varying the current to the motor **151** or **351** to control the speed of the motor **151** or **351** in accord with the selected speed.

At process **523**, an adjustment to a motor torque is selectively implemented based on a load on the treadmill. The "load" on the treadmill refers to the force that the user is imparting to the belt to at least partly cause the running belt to rotate. However, this load may be different than the force applied by the motor **151** or **351** in causing the running belt **30** or **230** to rotate at the selected speed of process **522**. For example, if the user is imparting a relatively greater force to the running belt than the torque provided by the motor, the running belt may slip relative to the at least one of the front and rear running belt pulleys. Thus, at process **523**, the controller **450** may control the torque output of the motor **151** or motor **351** to compensate for the load applied to the treadmill to prevent or substantially prevent various undesired circumstances, such as slippage of the running belt. As a result and in use, a relatively smoother operation characteristic may be experienced.

At process **524**, speed of the running belt is monitored and compared relative to the selected speed. In this regard, the controller **450** may utilized a closed-loop control technique that monitors the speed to ensure or substantially ensure the speed is at or about the selected speed.

At process **525**, an exit command is determined to be received. As mentioned above, the "exit command" refers to any type of command or instruction received by the treadmill **10** or treadmill **200** that causes the operation mode (in this case, the motorized operation mode) to end. For example, the exit command may be an explicit instruction received from the user (e.g., the pressing of a stop button, the removal of the magnet from contacting the e-stop magnet contact, etc.). Or, as another example, the exit command may be an implicit instruction. For example, the user may have stepped off the treadmill, however the motor is still causing the running belt to rotate at substantially the selected speed in the designated direction. To prevent continued operation, a weight sensor may acquire data indicative that no load or weight is being applied to the running belt (or a weight or load below a certain predefined threshold) for a predefined amount of time and then turn the treadmill off. Such an action may be a back-up to the explicit instruction action. Like mentioned above in process **510**, if the exit command is determined to be received by the controller **450**, the treadmill **10** or **200** is stopped (process **550**). This may include turning various powered electronics off (e.g., display devices) to conserve energy. If the exit command is determined to not be received by the controller **450**, the treadmill **10** or **200** may continue operating in the designated mode of operation.

In response to receiving an indication that the user desires to operate the treadmill **10** or treadmill **200** in the brake mode of operation, process **530** is initiated. The brake mode of operation includes processes **531**-**535**, which are explained herein below.

At process **531**, a forward or reverse belt rotation mode designation is received. In this regard, process **531** is analogous to process **521**.

At process **532**, a motor speed is set to a threshold value. In one embodiment, the threshold value is zero revolutions-per-minute (RPM). In another embodiment, the threshold value is another value corresponding to less than a selected running belt rotation speed. In this regard, the controller **450** controls the motor **151** or **351** to not rotate (when at zero RPM) to not or substantially not drive or move the running belt **30** or **230**.

At process **533**, a holding torque of the motor is adjusted. The holding torque refers to the torque required or sufficient for rotating the output shaft of the motor while the motor stays energized. In this regard, the holding torque represents the resistance or braking force applied to the running belt **30** or **230** that may make rotation of the running belt difficult or comparably easier. Thus, the holding torque can be increased or decreased, whereby increasing the holding torque increases the torque required to rotate the output shaft of the motor (e.g., increases a resistance experienced by a user in moving the running belt) and decreasing the holding torque decreases the torque required to rotate the output shaft of the motor (e.g., reduces a resistance experienced by a user in moving the running belt). In operation, a holding torque level (e.g., an indicator such as a numerical value, or a scale value (1/10), etc.) may be presented to a user on the display device **16** or **216**. In response, the user may, via the handrail switch assembly **433** or one or more buttons on the display device **16** or **216** increase or decrease the holding torque. As a result, the force or load imparted by the user onto the running belt **30** or **230** that is required to rotate the running belt **30** or **230** in the designated direction may vary to affect the resistance experienced by the user. For example, a user who desires a high resistance workout may increase the holding torque to a maximum amount or near maximum amount. In comparison, a user who desires a relatively low resistance workout may decrease the holding torque to a relatively low value. In each instance, the user must overcome the holding torque to cause the running belt **30** or **230** rotate in the designated direction.

At process **534**, the motor maintains the threshold value of motor speed in response to the adjusted holding torque. For example, the motor **151** or **351** may continue to hold the output shaft at zero RPM yet adjust the torque output to correspond with the designated holding torque level or value. Due to the characteristics of the motor **151** or **351** (e.g., the brushless DC motor shown in FIG. as **441**), the torque and speed of the motor may be related. As such, there may be variance in the threshold value of motor speed in response to adjustment of the holding torque. In any event, by holding the motor speed to a low value (e.g., zero RPM), the motor **151** or **351** substantially does not drive the running belt **30** or **230**. Rather, the user drives the running belt by overcoming the holding torque of the motor **151** or **351** to cause rotation or movement. Such a characteristic may be beneficial for users seeking to strength train.

At process **535**, an exit command is determined to be received. As mentioned above, the "exit command" refers to any type of command or instruction received by the treadmill **10** or treadmill **200** that causes the operation mode (in this case, the brake mode of operation) to end. Process **535** may be substantially similar to process **525**, such that the same, similar, additional, or different explicit and implicit data may be used to determine whether an exit command was received. If the exit command is determined to be received by the controller **450**, the treadmill **10** or **200** is stopped (process **550**). This may include turning various powered electronics off (e.g., display devices) to conserve energy. If the exit command is determined to not be received by the controller **450**, the treadmill **10** or **200** may continue operating in the designated mode of operation.

In response to receiving an indication that the user desires to operate the treadmill **10** or treadmill **200** in the torque mode of operation, process **540** is initiated. The torque mode of operation includes processes **541**-**545**, which are explained herein below.

At process **541**, a forward or reverse belt rotation mode designation is received. In this regard, process **541** is analogous to processes **521** and **531**.

At process **542**, a holding torque of the motor is disabled. In this regard, the controller **450** either directly or through the motor controller **440** provides a command to disable the holding torque. In this regard, the output shaft **152** of the motor **151** and output shaft **352** of the motor **351** are free to rotate. As such, no or little resistance from the motor **151** or motor **351** is being provided to the shaft assemblies and, in turn, to the running belt **30** and **230**. Therefore, the running belt **30** and **230** is substantially able to freely rotate in the designated rotation direction.

At process **543**, a torque assistance setting is received. The "torque assistance setting" refers to a value, setting, indicator, etc. used to control a torque output from the motor. In this regard, a higher torque assistance setting may correspond with a higher torque output from the motor (up to a maximum or substantial maximum amount per the specifications of the motor). The torque assistance setting may be received from a user via the display device **16** or **216** or via the handrail switch assembly **433**. As an example, up/down arrows may be provided on the display device **16** or **216** whereby a user can adjust the torque assistance setting by moving the up/down arrows. In operation and based on the received torque assistance setting, motor **151** or **351** provides a torque output in the corresponding designated running belt **30** or **230** designated direction (process **544**). The torque output helps or aids the user rotate the running belt **30** or **230**. Such an action reduces the effort required of the user to operate the treadmill **10** or **200** (i.e., move the running belt **30** or **230**). Therefore, such an action may be appealing to those rehabilitating injuries, elderly users, fitness beginners, and the like.

At process **545**, an exit command is determined to be received. As mentioned above, the "exit command" refers to any type of command or instruction received by the treadmill **10** or treadmill **200** that causes the operation mode (in this case, the torque mode of operation) to end. Process **545** may be substantially similar to process **535**, such that the same, similar, additional, or different explicit and implicit data may be used to determine whether an exit command was received. If the exit command is determined to be received by the controller **450**, the treadmill **10** or **200** is stopped (process **550**). This may include turning various powered electronics off (e.g., display devices) to conserve energy. If the exit command is determined to not be received by the controller **450**, the treadmill **10** or **200** may continue operating in the designated mode of operation.

As utilized herein, the terms "approximately," "about," "substantially," and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and are considered to be within the scope of the disclosure.

It should be noted that the term "exemplary" as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples).

For the purpose of this disclosure, the term "coupled" means the joining of two members directly or indirectly to one another. Such joining may be stationary or moveable in nature. Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another. Such joining may be permanent in nature or may be removable or releasable in nature.

It should be noted that the orientation of various elements may differ according to other exemplary embodiments and that such variations are intended to be encompassed by the present disclosure.

It is important to note that the constructions and arrangements of the manual treadmill as shown in the various exemplary embodiments are illustrative only. Although only a few embodiments have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and omissions may also be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present disclosure.

What is claimed:

1. A treadmill, comprising:
- a frame;
- a running belt configured to rotate relative to the frame; and
- a motor coupled to the running belt, the motor operable in a plurality of user controlled operating modes such that:
  - in a first operating mode, the force of rotation of the running belt is provided by a user of the treadmill;
  - in a second operating mode, the motor applies a desired braking force to resist rotation of the running belt; and
  - in a third operating mode, the motor applies a torque output to the running belt based on a force exerted on the running belt by a user of the treadmill.

2. The treadmill of claim **1**, wherein in the second operating mode, the rotation of the running belt is resisted by the desired braking force in one of a first rotational direction of the running belt or in a second rotational directional of the running belt, the second rotational direction being opposite the first rotational direction.

3. The treadmill of claim **1**, further comprising a front running belt pulley coupled to the frame and a rear running belt pulley coupled to the frame, the front running belt pulley and rear running belt pulley each adapted to at least partially support the running belt.

4. The treadmill of claim **1**, wherein the running belt defines a substantially planar running surface.

5. The treadmill of claim **1**, wherein the running belt defines a non-planar running surface.

6. The treadmill of claim **1**, wherein the desired braking force is a user definable setting, wherein increasing the desired braking force increases a force required by the user to rotate the running belt and decreasing the desired braking force decreases a force required by the user to rotate the running belt.

7. A treadmill, comprising:

a running belt; and

a motor coupled to the running belt, the motor operable in a plurality of operating modes such that:

in a first operating mode, the motor applies a desired braking force to resist rotation of the running belt; and

in a second operating mode, the motor applies a torque output to the running belt based on a force exerted on the running belt by a user of the treadmill.

8. The treadmill of claim **7**, wherein the motor is operable in a third operating mode, wherein in the third operating mode, rotation of the running belt is provided solely by a user of the treadmill.

9. The treadmill of claim **8**, wherein in the third operating mode, a holding torque of the motor is disabled to allow the running belt to freely or substantially freely rotate.

10. The treadmill of claim **9**, wherein in the third operating mode, the running belt moves in a first rotational direction or in a second rotational directional, the second rotational direction being opposite the first rotational direction.

11. The treadmill of claim **7**, wherein in the second operating mode, the motor rotates the running belt at a desired speed and applies the torque output to compensate for a load applied to the running belt by the user of the treadmill.

12. The treadmill of claim **7**, further comprising a controller coupled to the motor, wherein in the first operating mode, the controller is configured to receive an exit command to exit the first operating mode, and wherein in the second operating mode, the controller is configured to receive an exit command to exit the second operating mode.

13. The treadmill of claim **7**, further comprising:

a frame;

a front shaft assembly coupled to the frame; and

a rear shaft assembly coupled to the frame and spaced apart from the front shaft assembly;

wherein the running belt is disposed about the front and rear shaft assemblies.

14. The treadmill of claim **13**, wherein the motor is coupled to the front shaft assembly, and wherein in the first operating mode, the desired braking force provided by the motor is applied to the front shaft assembly.

15. The treadmill of claim **13**, wherein the motor is coupled to the rear shaft assembly, and wherein in the second operating mode, the desired braking force provided by the motor is applied to the rear shaft assembly.

16. The treadmill of claim **7**, wherein the running belt defines a non-planar running surface.

17. The treadmill of claim **7**, wherein the running belt defines a substantially planar running surface.

18. A treadmill, comprising:

a frame;

a running belt coupled to the frame and adapted to move relative to the frame; and

a motor coupled to the running belt, the motor operable in a plurality of operating modes such that:

in a first operating mode, rotation of the running belt is driven by a user of the treadmill; and

in a second operating mode, the motor rotates the running belt at a desired speed and selectively applies a torque output to compensate for a load applied to the running belt by a user of the treadmill.

19. The treadmill of claim **18**, wherein in a third operating mode, the motor applies a desired braking force to resist rotation of the running belt.

20. The treadmill of claim **18**, wherein the running belt defines a substantially planar running surface.

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